PHILOSOPHY
OF
RENATE DES
CARTES

1694

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LE GRAND, A

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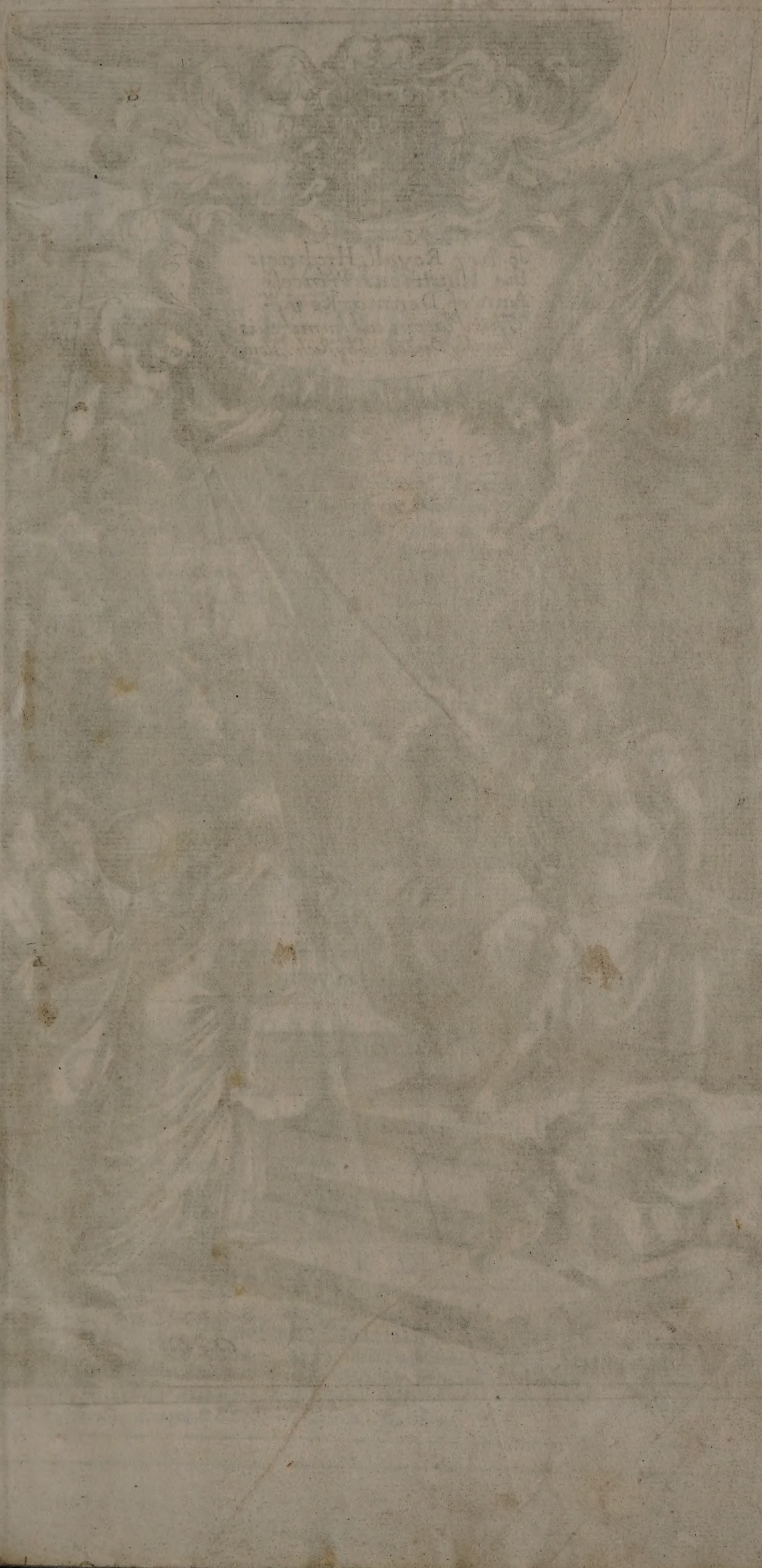


To her Royall Highness
the Illustrious Princess
Ann of Denmarke &c.
This Plate in all humility is
humbly Dedicated by Rich: Blome
Clare
et
Distine
te
G. Freman Inv.
I. Kip Sculp.

AN ENTIRE

Body of Philoſophy,

According to the

PRINCIPLES

Of the Famous

RENATE DES CARTES,

In Three Books:

I. The INSTITUTION, in X. Parts; 1. *Logick.* 2. *Natural Theology.* 3. *Dæmonology,* or of *Created Spirits.* 4. *General Phyſicks,* or *Natural Philoſophy,* generally conſidered. 5. *Special Natural Philoſophy,* of the *World* and *Heaven.* 6. The Four Great Bodies, *Earth, Water, Air* and *Fire,* and what have their riſe from them; where, of *Metals* and *Meteors.* 7. Of *Living Things* in general, and in particular of *Plants* and *Animals.* 8. *Man,* in reſpect to his *Body.* 9. *Man,* as to his *Mind* or *Soul.* And, 10. *Ethicks,* or *Moral Philoſophy,* treating of *Man*'s right Ordering his Life.

II. The HISTORY of NATURE, which Illuſtrates the *Inſtitution,* and conſiſts of great Variety of *Experiments* relating thereto, and explained by the ſame *Principles,* in IX. Parts, 1. Of *Bodies.* 2. Of *Qualities.* 3. Of the *Earth* and *Heaven.* 4. Of the *Earth, Water, Fire* and *Air.* 5. Of *Things* dug out of the *Earth.* 6. Of *Meteors.* 7. Of *Plants.* 8. Of *Animals.* And, 9. Of *Man.*

III. A Diſſertation of the Want of SENSE and KNOWLEDGE in BRUTE ANIMALS, in II. Parts, giving a *Mechanical Account* of their Operations.

Written Originally in Latin by the Learned

ANTHONY LE GRAND.

Now carefully Tranſlated from the laſt Corrections, Alterations, and large Additions of the Author, never yet Publiſhed.

The Whole WORK Illuſtrated with almoſt an Hundred

SCULPTURES

Diſperſed to ſuch places as beſt admit thereof: All deſigned, Drawn and Engraven *Hiſtorically* by good Artiſts. Beſides the FIGURES or SCHEMES for the Explanation of the *Philoſophical Parts* that require the ſame.

Endeavoured to be ſo done, that it may be of Uſe and Delight to the Ingenious of both Sexes.

By RICHARD BLOME

LONDON:

Printed by *Samuel Roycroft,* and Sold by the Undertaker *Richard Blome,* dwelling in *New Weld-ſtreet,* at the *Green Pales,* near *Clare-Market:* And at theſe Bookſellers following; Mr. *Horn* and Mr. *Southby* by the *Royal Exchange*; Mr. *Chiſwell,* Mr. *Clavell* and Mr. *Brome,* in S. *Pauls Church-yard*; Mr. *Tonſon,* in *Fleetſtreet*; Mr. *Saunders,* in the *New Exchange*; Mr. *Gilliflower,* in *Weſtminſter-Hall*; and Mr. *Richards,* at the *Bible,* the Corner of *Eſſex-Street,* againſt S. *Clements* Church. M DC XC IV.

AN ENTIRE

Body of Philosophy,

According to the

PRINCIPLES

Of the Famous

RENATE DES CARTES,

In Three Books:

WELLCOME HISTORICAL MEDICAL LIBRARY

TO THE

Right Honourable, and Truly Noble,

HENRY

Lord Viſcount *Sydney* of *Shepey*,

Baron *Milton*, Lord Lieutenant of *Kent*, Conſtable of *Dover Caſtle*, Lord Warden of the *Cinque Ports*, Maſter General of Their Majeſties *Ordnance*, Colonel of Their Majeſties Firſt Regiment of Foot Guards, one of the Gentlemen of His Majeſties Bedchamber, and one of the Lords of Their Majeſties Moſt Honourable Privy Council, *&c.*

My Lord,

I *Am not unſenſible that ſome part of the* World, *when they ſhall ſee your* Lordſhips Name *affixt to this* Book, *will be apt to ſay, That my inducements for laying it at your* Honours Feet, *are thoſe generally made uſe of by* Authors; *to wit, the neceſſity of an* Illuſtrious Patronage *to defend the* Work *againſt the aſſaults of* Envy *and* Ignorance: *But I muſt beg leave to aſſure your* Lordſhip *and the* World, *that the true* Reaſon *for this my* Dedication, *ariſeth from a well-grounded Belief, and the general concurrence of the* Learned *Part of this* Nation, *that your* Honour *is the propereſt* Perſon *to* patroniſe *a* Work *of this* Nature, *having by all the* Actions *of your* Admired Life *fully convinced the* World, *that you only are the* abſolute Maſter *of the whole* Body *of* PHILOSOPHY; *and I my ſelf have ever held it as a reaſonable* Poſition, *That the* Works *of the* Learned, *like the* Actions *of the* Noble, *ought only to be judged by their* Peers; *nor can I think your* Lordſhip, *or any* Learned Perſon *will ſay, that a* virtuous deſire *of* Knowledge (*and ſuch I humbly conceive is* Philoſophy) *needs or wants a* Protection *from any, ſince 'tis an experienced* Truth, *That* Virtue *carries her own* Safeguard, *as well as her own* Reward.

But as to the Subject Matter *of this* Book, *and the method of handling it, I ſhall not ſay any thing, but refer your* Lordſhip *to the* Book *it ſelf, of which your* Honour *is ſo great a* Judge; *having in my* memory, *the admonition of* Apelles *to* Alexander the Great, *ſpeaking improperly of the* Noble Art of Painting; *In things you underſtand not, ſays that Great* Artiſt, *be alwaies* ſilent, *leſt by* ſpeaking, *you betray a want*

of Judgment. *But as for the* Deſigning *and* Engraving *the* SCULPTURES *which Imbelliſhes this* Work, *things more properly mine, than any other part of the* Book, *and in which through* Practice *and* Experience *I may be allowed to have ſome* knowledge; *I muſt beg leave to aſſure your* Lordſhip, *that they are, if not* accurately, *at leaſt* elaborately *done; and had I not been therein concern'd, might have ventured to have ſaid, they are the beſt ever made* publick *in this* Nature *and* Nation. *And if they be ſo happy as to contribute in the leaſt to your* Honours Satisfaction, *or* Entertainment, *I ſhall thereby be abundantly rewarded for all my* Care, Charge *and* Trouble; *for the very* White *at which I aimed, both in* publiſhing *this* Book, *and* writing *this* Epiſtle, *was to have it in my power to declare to your* Lordſhip, *that the ultimate of my Ambition is to ſerve you whilſt I* Live, *and when* Dead, *to be recommended to* Poſterity *under this deſirable* Character, *That I had the happineſs to be known to your* Honour, *who is allowed by all the* Judicious, *to be the Glory of the* Age *you live in, and to excel all that have gone before you, and to ſtand a Great, Noble, and hardly to be pattern'd* Example *to thoſe that ſhall ſucceed. And of You, moſt Noble* Sir, *'tis with more* Truth *than* Complement *ſaid, that* HENRY *Lord* SYDNEY *doth abundantly ſurpaſs both in* Wiſdom *and* Heroick Performances, *the ſo much famed Sir* PHILIP SYDNEY (*whom, the Age he lived in, thought worthy to be a King*) *and that in times to come they will mention his* Alliance *to you, to aggrandize his* Character. *Nor are theſe, my* Lord, *half the* Hecatombs *of* Praiſe *offered up to your great* Merit, *by the* grateful *and* underſtanding *part of* Mankind; *nor one third of what I might juſtly ſay: But ſuch is your* Lordſhips *great* Modeſty, *to be equalled by nothing but your* Courage, *that you always decline* hearing *a recital of your Illuſtrious* Actions, *tho' you never omit any opportunity of* performing *them: And therefore I ſhall only beg leave to tell your* Honour, *with all due Deference to your* Exalted Station; *that there is no part of the* World *which You have graced with Your* Preſence, *and obliged with Your* Goodneſs, *is, or can be more truly ſenſible of what they owe You, or more willing entirely to* ſacrifice *their* All *to your* Lordſhips Service, *than the* Publiſher *of this* Work; *who is, may it pleaſe your* Honour, *with the moſt profound Reſpect imaginable,*

My Lord,

Your Honours

moſt Obliged, and moſt Humble Servant,

Richard Blome.

THE

THE EPISTLE TO THE READER.

BY my indefatigable *Labour* for theſe twenty Years, I have employed my time, with no ſmall *Expences* in the *Printing* of ſeveral *Volumes*, not only *Uſeful*, but *Honourable* to this *Nation*, which have met with a kind Reception from the *Nobility* and *Gentry*, ſome of which I ſhall here give the *Reader* a ſhort account of, as having a ſmall quantity of each remaining, which the Curious may be accommodated with. And this their *Encouragement* has emboldned me to undertake this Great Work in *Engliſh*, which of all *Subjects*, is the moſt wanting; and the rather, becauſe appearing in our *Native Tongue*, 'tis thereby more uſeful for the *Publick Good*, and of more univerſal *Benefit*. For it ſeems a kind of *Illnatur'd Retrenchment* upon the common *Freedom* of *Mankind* to lock up all Ingenious *Arts* and *Sciences* from them, unleſs they are *Maſters* of a *Greek* or *Latin Key* to open 'em. The *Travel* into PHILOSOPHY and true *Wiſdom*, like the *Commerce* into the Rich *Indies*, ſhould be declared *Free*, and of equal *Right* to all the *Subjects* of *England*, without incurring the *Premunire* of *Interlopers*.

Tongues and *Languages*, I confeſs are a fine and ſumptuous *Portico*; but then they are no more than a *Portico*. The *Sciences* to which they introduce, are the *Main Maſs* and *Body* of true *Learning*; and 'tis ſomewhat of the hardeſt, that ſo fair a *Pile* ſhould have that only *Gate* to enter at: Beſides, not to inſtance how many, otherwiſe very ingenious *Men*, are hereby debarr'd the *Study* of *Wiſdom* and *Virtue*, whilſt couch'd only in a *Language*, which poſſibly their *Education*, or want of *Leiſure* has not made them *Maſters* of: Here's a perfect *Turkiſh* piece of *Cruelty*; for we thus make *Learning* an abſolute *Mahometan Moſque*, whilſt the whole Fair *Sex* are at once excluded from any part of their *Devotion* in it. And let me tell you, the moſt complaiſant *French Authors* generally *Print* their *Philoſophical Books* in their own *Language*, by which the *French Ladies*, to the Glory of their *Sex*, have arrived to a great perfection of *Knowledge*; in which extraordinary *Accompliſhments*, being able to *diſcourſe* of the *Heavens*, the *Motion* of the *Planets*, and the *Nature* and *Cauſes* of *Mundane Things*, &c. beſide the Improvement of *Virtue*, they have elevated their *Converſation* above the Common Rate of *Feminine Eloquence*, ſuch as their deſcant upon *Commodes*, *New Faſhions*, or the little Vanities, and have added no little *Charm* and *Grace* to many Profeſt *Virtuoſo's*. And truly tho' we have at preſent ſet up our *Standard* againſt *France*, yet I could wiſh we might ſtill continue one piece of *Friendſhip*, *viz.* our old *Cuſtom* of following the *Mode* of *France*, in bringing that one *French Faſhion* up, of making our *Learning* ſpeak *Engliſh* to inſtruct both ours, and the Fair *Sex*.

And altho' this *Volume* of PHILOSOPHY has been ſo well received in *Latin* by the Sale of ſeveral *Impreſſions*, yet for the making it more exact and perfect, I contracted with the *Author* Mr. *Le Grand* to make *Additions* thereunto; ſo that by his large *Additions* and great *Alterations* throughout, it may be boldly ſaid to be a *New Book*, and the beſt yet extant in any *Language*.

My

The Epiſtle.

My next buſineſs was to employ an able *Tranſlator* and *Superviſor*, which with the care of the ſaid Mr. *Le Grand*, every thing throughout is rendred ſo facile, and adapted to the *Engliſh Dreſs*, as to be of *Uſe* and *Delight* to all *Perſons*. I have alſo *Engraven* the SCHEMES *or* FIGURES that were formerly in *Wood*, now on *Copper*: And for the adornment of the ſaid WORK, have *illuſtrated* it with above 90 SCULPTURES, *Hiſtorically* and *Poetically Deſigned*, and *Engraven* by good *Artiſts*, relating to the ſeveral *Subjects* that beſt admit thereof: And have added an *Explanatory* INDEX or TABLE of the ſeveral SCULPTURES, that the *Reader* may the better know the meaning thereof.

The SCHEMES *or* FIGURES are *Engraven* on three *Copper Plates*, two for thoſe in the *Inſtitution*, and one for thoſe in the *Hiſtory* of *Nature*, all numbred 1, 2, 3, 4, and ſo on as in the *Plates*, with reference to the *Book* by the *Folio*, and the ſaid number in the *Margent*; which ſaid *Plates* of *Schemes* are to be placed at the beginning of the *Book* next the *Preface* of Mr. *Le Grand*, which gives you an account of the *Work*, and the *Arms* of the *Benefactors* to follow the *Schemes*.

Richard Blome.

An Account of ſome Volumes *which the* Curious *may be accommodated with by me.*

The **Gentleman's Recreation**, in Two Parts, in large Folio. The firſt, of the *Liberal* and *Mathematical Sciences*; which in a brief and clear Method treats of the *Doctrin* and *General Parts* of each *Art*, with *Eliptical Tables* engraven on *Copper Plates*, for the better comprehending the ſame. The Second Part at large treats of **Horſemanſhip, Hawking, Hunting, Fowling, Fiſhing** and **Agriculture**; all being Collected from the moſt Authentick *Authors*, and the many groſs Errors therein Corrected, with great *Enlargements* made by thoſe well Experienced therein. And for the better Explanation thereof great variety of uſeful *Sculptures*, as *Nets*, *Engins*, *Traps*, &c. are added, for the taking of *Beaſts*, *Fowl* and *Fiſh*, not publiſhed by any: Nothing material being omitted for the rendring them Compleat. The whole Illuſtrated with about 86 Ornamental *Copper Plates*; in Folio.

The *Hiſtory* of the **Old** and **New Teſtament**, treating of the moſt remarkable Tranſactions therein, with good and uſeful *Morals*, for the better government of our Actions in all Conditions. To which is added, the *Travels*, *Voyages* and *Lives* of the *Apoſtles*; with a large **Hiſtorical Chronology** of ſuch Matters of Note that are related in the *Bible*: *Collected* and *Tranſlated* by good *Hands*, from Authentick *Authors*. The whole Illuſtrated with about 240 **Sculptures**, of the moſt remarkable Paſſages, performed by good *Artiſts*, far ſurpaſſing any *Collection* hitherto done, to the end it may be the more acceptable to the Curious. This *Work* is Printed in Two *Volumes* in large Folio, of a fair Print, and chiefly deſigned for the Curious.

The ſaid *Work* is likewiſe Printed in large *Octavo*, with all the *Sculptures*, as deſigned for a more general Sale, for *Youth*, to Inſtruct them in the *Hiſtorical* parts of the *Bible*: *Sculptures* being lively *Emblems*, to imprint the ſame in their *Memories*.

A uſeful *Volume* of **Coſmography** and **Geography**, in Two Parts, in Folio. The Firſt, of the Arts of *Coſmography* and *Geography*, being a *Tranſlation* of the much Eſteemed *VARENIUS*. The Second Part is a *Geographical* Deſcription of the *World*, from the *Works* of the Famous Monſieur *SANSON*; with about a 100 *Geographical* Tables of the *Kingdoms* and *Iſles* in the *World*, with their Chief Places, drawn from the Maps of the ſeveral *Kingdoms*, which illuſtrates this *Work*. And to this *Impreſſion* are added the *County Maps* of *England*, drawn from thoſe of *Speed*'s in a ſmaller *Scale*.

THE

THE PREFACE.

SECTION I.

Of the *Nature, Principles, Object, Use, Rise* and *Progress* of PHILOSOPHY.

PHILOSOPHY, *according to its Etymology, is the* love *and* ſtudy *of* Wiſdom; *where by* Wiſdom *we underſtand ſuch a diſpoſition of the* Mind, *by which Man is firmly inclined to have right Sentiments of the* Things *that occur to his perception, and to make a juſt Examination of the* Actions *that belong to his* Life. *For* Wiſdom *doth not only direct the* Underſtanding, *and guide the* Mind *in the Contemplation of* Truth; *but alſo inclines it to* Honeſty, *and aſſiſts the* Will *in the proſecution of* Vertue: *So that* Wiſdom *is indeed nothing elſe but a perfect Knowledge of all thoſe things which it is poſſible for* Man *to know, and which may be both a* Rule *to his* Life, *and a* Help *to the Inventing of all* Arts *whatſoever.* What *PHILOSOPHY* is.

Whence PHILOSOPHY may be defined a Habit *of the* Mind, *acquired by Study and Exerciſe from Inborn* Idea's *and ſelf evident* Principles, *enlightning the* Underſtanding *into the knowledge of neceſſary things, and perfecting the* Will *by Honeſt and Vertuous* Actions. How it is defined.

Now to the end this Science *may have theſe* Effects, *it is neceſſary that it be deduced from* firſt Cauſes; *ſo that whoſoever deſires to be* Maſter *of it, muſt begin with an enquiry into theſe* Cauſes: *Becauſe this is the firſt property of the* Principles *of* Things, *to be ſo clear and evident as not to ſtand in need of any proof of their Certainty, and to be raiſed beyond the reach of Doubting; ſo that whoſoever minds them, can't doubt of their* Truth. *Secondly, They are ſuch on which other things depend, and without the knowledge whereof nothing of* Certainty *can be had. Wherefore tho' the* firſt Cauſes *of Things may be known, tho' the* Things *themſelves be unknown; yet it is impoſſible, but that when theſe are known, thoſe muſt be likewiſe known; becauſe the* Truth *of theſe depends on the evidence of their* firſt Cauſes. *And accordingly whatſoever is demonſtrated concerning them, without a ſelf-evident* Principle *muſt needs be dark and uncertain. For as* DESCARTES *ſaith*; No *Concluſions* deduced from an unevident *Principle*, can be evident, tho' they ſhould be deduced thence with the greateſt Evidence imaginable. Of what kind the Principles of Philoſophy are to be.

It is not only one Genus, *or general Head of things, that is the Object of PHILOSOPHY; but ſhe extends her ſelf to all things which the* Mind *of* Man *is capable of knowing. And therefore* Plato, *as* Ammonius *tells us, called it* The knowledge of things Human and Divine; *foraſmuch as it doth not only conſider* Corporeal Things, *but alſo contemplates the* Supream Cauſe *and* Intelligences *void of Matter, and enquires into their* Attributes *and* Perfections. *For* this is it (*ſaith* Cicero) which diſpels all dimneſs from the Eye of the Soul, and enableth us to ſee all things, whether Superior or Inferior, firſt, laſt, or middlemoſt. What is the Object of Philoſophy.

From whence we may gather the true Uſe of PHILOSOPHY, and how many Advantages it affords us. For, firſt it helps the Soul *to contemn thoſe* Tranſitory *and* Temporal things, *to which from its* Childhood *it has been too much addicted, and raiſes its* deſires *to things* Heavenly *and* Eternal. *Secondly, It aſſiſts us in the thorough ſearch into our own* Natures, *in the knowledge of our* Creator, *and the attentive Conſideration of his* Works. *Thirdly, Whilſt it evidenceth* Truth *to us by clear and indubitable* Demonſtrations, *it affords us extraordinary pleaſure and delight, as diſplaying thoſe things in a full light to us, which are hid from the greateſt part of* Mankind. *Fourthly, It removes* Wonder, *which ever is the Companion of* Ignorance, *and gives us a clear Light, whereby to diſcern Great things from Small, and to eſteem things according to their true Value. Fifthly, By the Exerciſe hereof we are prepared to know the ſeveral* Objects *we meet with more diſtinctly, and to judge of them with more Caution and Exactneſs; for by the long continued* Study *of* Philoſophy *we become more prudent and cautious in paſſing Sentence concerning things.* What is the Uſe of Philoſophy.

Whence Philosophy had its rise.

PYTHAGORAS was the first amongst the Ancients *who assumed the Name of* Philosopher, *by way of Modesty, as condemning the Pride and Arrogance of others who would be called* Sophi, *that is,* Wise Men. *For this discreet Person was so sensible of our Ignorance, that he thought that* that Title *did beseem* God *alone, and could not deservedly be given to any* Mortal. *But because the Original of* Wisdom *and* Philosophy *is one and the same, which was many Ages before* Pythagoras, *we must look for it long before his time: Which if we do, we shall find that it could not proceed from any one else but* God, *the* Father of Lights, *from whom every* perfect Good *comes, and the* Truth *of all things is derived. Hence it is the* Poets *tell us, That* Pallas *or* Minerva, *the* Goddess *of* Wisdom, *was the birth of* Jupiter's Brain; *intimating thereby that all* Knowledge *comes from* GOD, *and takes its rise from his* Understanding. *For it is certain that* Adam, *the first of Mankind, was a* wise Man, *forasmuch as he gave* Names *to* Things, *and taught his* Sons *the knowledge of the* Stars, *which he could never have done, if he had not been endued with* Wisdom, *and understood the Nature and Property of* Things.

How Philosophy has been transmitted to us from *Adam*.

It is probable that this most excellent Gift of God, *was handed from* Adam *by* Methusalem *to* Noah, *and from him, his* Sons *and* Grandchildren, *to the* Chaldeans *and* Hebrews, *who were famous for their Knowledge of many things, and from them to the* Egyptians; *from the* Egyptians *to the* Grecians, *and from them to the* Romans; *from whom, in process of time, the same was derived to the* Northern *and* Western Nations.

How some think it had its rise according to the Nature or scituation of Countries.

Some that begin not the Pedigree *of PHILOSOPHY so high as we do, tell us, That it had its* rise *according to the Nature or Scituation of the* Countries *where those lived who had the first Knowledge of it*: Necessity, *which is usually the first* Mistress *of* Sciences, *having taught them what were proper for their Needs. 'Twas thus, say they, that the EGYPTIANS began to observe the Increase and Decrease of the* Nile, *and to make every Year a* Prognostick *of the Fruitfulness or Sterility of their* Lands. *And to part, with the more facility their* Harvest, *among those particular Persons who were to have their Shares thereof, they learnt the first Principles of* Geometry. *The ASSYRIANS, who inhabited vast and unclouded* Countries, *having nothing to hinder them from contemplating the* Stars, *were the first that observed their* Motion; *and the CHALDEANS, who were amongst these People a kind of* Philosophers, *found from this Speculation an* Art *of* Foretelling things to come. *In fine, The PHÆNICIANS, who were Neighbours to the* Sea, *drew another Benefit from the Knowledge of the* Stars, *and addicted themselves to observe those which might be useful to* Navigation; *in which they succeeded so well, that they found out that there was a fixed* Point *towards the* Pole, *the observation of which might be a Guide to* Pilots.

SECTION II.

The Chief and most Celebrated PHILOSOPHERS.

THALES. *Amongst those who are most Celebrated for* Philosophy, *THALES the* Milesian, *so called from* Miletus *the Capital City of* Ionia, *in which 'tis said he was born, 639 years before* Christ, *is accounted the first. He was a great* Astronomer, *and the first that observed the* Solstices *and* Equinoxes. *His Opinion was, That* Water *was the* Principle *of all* Things.

ANAXIMANDER. *The Successor of* Thales *was ANAXIMANDER, who was also Born at* Miletus, *and the first Founder of the* Ionick Sect. *He distinguished the* Four Elements, *placed the* Earth *in the* Center, *and by the scituation he gave them, was the first that erected a kind of* System *of the* World. Strabo *and* Laertius *assure us, that he was the first also that made* Maps. *He never determined, as* Thales, *which of the* Elements *was the* Principle *of* Natural things, *but concluded it to be* Immense.

ANAXIMINES. ANAXAGORAS. ARCHELAUS. HERACLITUS DEMOCRITUS. *ANAXIMINES followed* Anaximander, *being also Born in the same* City. *He owned* Infinite Air *to be the* Principle *of all* Things. *His* Disciple *was ANAXAGORAS of* Clazomene, *who was the first that brought* Philosophy *from* Ionia *to* Athens. *He declared* Matter *and* Spirit *to be the* first Principles; *that at the* Beginning *all Things were in* Confusion, *and that it was the* Spirit *that separated, distinguished and establish'd them in that beautiful Order wherein we see them.* Anxagoras *his Scholar was ARCHELAUS the* Athenian, *who was the Asserter of* Similar Parts, *and held* Heat *and* Cold *to be the* Principles *of all* Things. *To these also may be added, HERACLITUS the* Athenian, *who maintained that the* first Principle *was* Fire. *And DEMOCRITUS the* Abderite, *who would have it to be* Atoms. *These were of the* Ionick Sect.

PYTHAGORAS. *PYTHAGORAS of* Samos, *flourished in the Year 571 before* Christ, *and was the first that Instituted the* Italick Sect, *in that part of* Italy *commonly called* Great Greece, *now* Calabria. *He took a different course from his Predecessors, vailing his* Natural *and* Divine Philosophy *under*

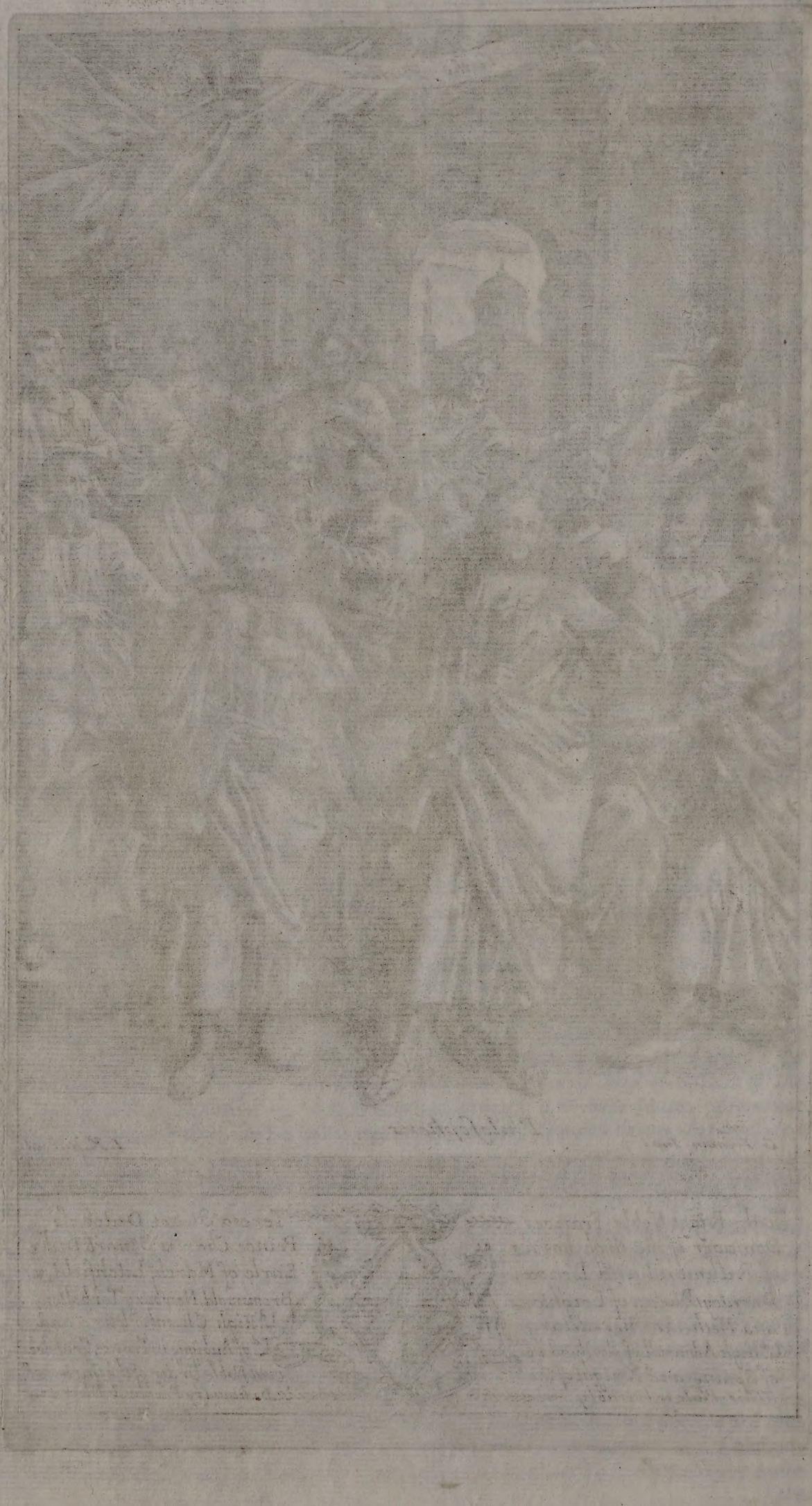
Philosopheris

G. Freman. Inv. I. Kip Scul.

To the Right Noble Frances Dowager of the High borne of Richmond and Lenox, Darnley, Baron of Leighton, and Metheuen; Hereditary L.d High Admirall of Scotland, &c.a of Spaine and Knight of the

Teresa Stuart, Dutchess Prince, Charles Stuart Duke Earle of March, Litchfield, & Bromswold, Newbury, Torbolton, L.d High Chamberlaine, and L.d of Aubigny in France, Grandee most Noble Order of the Garter &c.

This Plate is humbly Dedicated by Richard Blome



the secret Science of Numbers, *and was full of* Symbolical *and* Figurative Expressions, *being perswaded that it was to profane the* Truth, *to expose it naked to the Eyes of the People. His* Disciples *were not permitted to speak of the* Mysteries *he taught them, till after five Years continual* Silence. *It was his Fundamental* Maxim, *that* Unity *was the* Principle *of the Generation of all* Things, *and that* Plurality *was the* Corruption *of them. To these Numbers he added a certain* Harmony, *by which he explained the* Perfection *of all* Things. Vertue (*according to him*) Health, *the* Soul, *and* God *himself is nothing but an* Harmony, *and there is nothing more known than the* Harmony *which this* Philosopher *imagin'd to Rule the* Celestial Orbs. *He held the* Transmigration *of* Souls, *discovered the* Qualities *of each* Element, *the* figure *of their* Bodies, *the* roundness *of the* Earth, *and the* Antipodes. *He distinguished the* Seasons, *observed the different* Course *the* Sun *makes* daily *and* yearly, *and how the* Moon *receives her* Light *from it.*

SOCRATES, who was Born at Athens 468 *years before* Christ, *leaving the Study of* Natural Philosophy, *wholly addicted himself to* Ethicks. *Accordingly* Tully, *in the* Third Book *of his* Tusculan Questions, *tells us,* That all that *Philosophy* which undertakes the Conduct of *Life* and *Manners,* was derived from *Socrates; and therefore saith,* That he had called down *Philosophy* from *Heaven,* to take up its abode in *Cities* and *Houses.* *SOCRATES.*

PLATO, an Athenian, *was born in the year* 427 *before* Christ, *and for his extraordinary* Learning *and wonderful* Sagacity *in the searching out of* Truth, *had the Name of the* Divine Philosopher *bestowed upon him. His* School *set about with* Trees *was in the Suburbs of* Athens, *first called* Ecademia, *from one* Ecademus *the Possessor of it, and afterwards* Academia, *which gave the Name to his* Sect. *He concluded* God, Idea *and* Matter, *to be the* Principles *of all* Things. *Concerning his* Opinion *of these* Idea's, *the* Learned *are much divided. Some would have him hold that they are* Eternal Substances, Forms *existing from themselves, and distinct from the* Knowledge *of* God, *as Models quite separated from him, and such as upon which he forms the* Ground *of his* Work. *But others are of another* Judgment, *declaring that in his* Doctrin *the* Idea *of the* World *is no other thing than the* Image *the* Creator *has formed. As for* Matter, *he suppos'd it to be void of all* Form, *and that before the* Creation *of the* World *it was a kind of* Chaos, *yet capable of all* Forms: *And forasmuch as it hath a Disposition whereby it may be distinguished into divers* Bodies, *which* disposition *he makes to be nothing else than a* Pyramidal, Cubical, *or other kind of Figuration, of the least and invisible* Particles *of which the* Elements *are compounded; He consequently asserts, that* Pyramidal volatile Particles *constitute* Fire; *that* Cubical *and* subsiding Particles *make* Earth; Octahedrical *or* Eight corner'd, Air; *and* Eicosahedrical *or* Twenty corner'd, Water. *PLATO.*

ARISTOTLE, the Son of Nichomachus, *Born at* Stagyra *in* Macedonia 383 *years before the Birth of* Christ, *differed much in his Sentiments of* Philosophy *from his Master* Plato, *who therefore compared him to a* Colt *kicking his own* Dam. *He had the* Liceum *for his* School, *a House near* Athens, *which had been* Apollo's Temple, *built by a certain one called* Licus. *Here his* Disciples *Disputed* Walking, *from whence that place, according to the Greek word for it, was called PIRAPATUS, and they themselves PERIPATETICKS. This* Philosopher *became Famous by being the* Præceptor *of* Alexander the Great, *as well as by his sharp* Wit, *and the great number of his* Writings. *He held* Matter, Form *and* Privation *to be the* Principles *of all* Natural Beings. *ARISTOTLE.*

ARCESILAUS of Sardis *in* Lydia, *flourish'd in the Year* 297 *before* Christ, *and Taught at* Athens, *where he was the Author of a* Sect *called in after Times the* Middle Academy, *to distinguish it from the* Old Academy, *which begun with* Plato; *and from the* New, *which was instituted by* Lacides *of* Cyrene, *as will be presently declared. He asserted that there was no* Certainty, *but only a bare* Probability *in the* Knowledge *of* Things; *so that he thought we might equally hold* Pro *and* Con *upon all* Subjects, *and therefore would never determine, but always suspended his* Judgment. *ARCESILAUS.*

LACIDES the Cyrenean, *newly mention'd, Taught in the same* School *some years after* Arcesilaus, *and was the* Head (*as I said*) *of the* Sect *which was called the* New Academy. *He acknowledged that something was highly* probable, *at least that one thing was more* probable *than another, and accordingly determin'd; but was not sure that any thing was absolutely True.* *LACIDES.*

PYRRHO of Elæa, *was also the* Founder *of a* New Sect, *that is, a* New manner of Philosophizing; *for he had no* Dogma's *at all, as believing that nothing was* true *or* likely, *that is, so much as* probable. *He went beyond the* Academicians: *For whereas they comprehended, that* Nothing *could be comprehended, he did not comprehend that. His* Followers *were called EPHECTICI, from their* withholding their Assents: *SCEPTICI, from their* Considering *and* Canvasing: *ZETETICI, or* Seekers, *from their* Search *and* Enquiry: *And APOZETICI, from the continual* Doubts *and* Difficulties *they were used to object to the* Dogmatical Philosophers. *PYRRHO.*

ZENO. *ZENO the* Citian *had his* School *at* Athens *in a Painted* Gallery *called* Stoa, *whence his Diſciples had the name of* Stoicks. Vertue *was the Sovereign* Good *in his* Morals, *and he is famous for that* Conſtancy *he inſpired into his* Followers *in the extremity of* Affairs. *They would never confeſs* Pain *to be an* Evil. *He held the* firſt Matter *to be deſtitute of all* Qualities, *as of* Heat, Cold,&c. *as alſo without any* Form,Shape, *or* Figure. *He ſuppoſed that beſides the* World, *there was a certain infinite Space altogether void and empty, in which the* World *after its* Conflagration *might be reſolved. He aſſerted two* Principles, *viz.* God *and* Matter, *without which nothing could ſubſiſt.*

EPICURUS. *EPICURUS was Born at* Athens 257 *years before* Chriſt. *He kept his* School *in ſome* Gardens *in that* City, *and was the Author of a peculiar* Sect. *He Taught, as well as* ZENO, *the love of* Vertue; *but that only for the Pleaſure of it, and in that Pleaſure he comprehends that of* Senſe, *as well as that of the* Soul; *maintaining,* That a Wiſe Man could not be happy, if he enjoyed not all *Pleaſures Mankind* was capable of. *In this he did not ſo well explain himſelf, but that he gave occaſion of raiſing* Doubts *concerning his true* Conceptions; *ſome believing them to be* Innocent, *whilſt others, and thoſe the moſt numerous, think otherwiſe; inſomuch that the* Epicureans *are now generally look'd upon as too* Senſual. *The reſt of his* Morals, *concerning* God, Providence, *and the* Soul, *are alſo much blamed. He took from* DEMOCRITUS *the* Principle *of his* Phyſick, *adding thereto the declenſion of* Atoms, *with a motion of* Weight. *His* Opinions *were, That nothing was without* Beginning *or* End, *but* Atoms *and empty* Space: *That the* Univerſe *always abides unchangeable in the Whole, tho' as to its Parts it be variouſly altered. He endeavours to prove the neceſſity of an* Empty Space *from* Motion, *and aſſerts, that the* World *ſhall ſome time or other be* diſſolved *by the force of* Nature.

GASSENDUS. *The Famous PETRUS GASSENDUS,* Mathematick Profeſſor *in the* Univerſity *of* Paris, *Born in* Anno 1592, *hath endeavoured to Amend and Perfect the* Epicurean Philoſophy, *eſpecially by refuting its Errors concerning* God, Providence, *the* Souls Immortality, &c. *and by a cautious Explication of ſuch of his* Opinions *in* Natural Philoſophy, *which tho' not utterly condemned, yet not being ſufficiently proved, but Doubtful and Slippery, might be an occaſion of falling into* Error.

DES CARTES. *After all theſe was Born RENATUS DESCARTES, at* la Haye *in* France, *of a Noble and Ancient Family, in the year of our* Lord 1597, *who by a Method, before his Time but imperfectly known, reſtored* Philoſophy *from the very Foundations, opening a ſure and ſolid Way to* Mankind *into the inmoſt Receſſes of* Nature. *He was of ſuch a ſingular* Genius, *that he alone diſcovered more* Philoſophical Truths, *than ever were diſcovered in all foregoing* Ages. *We do not go about here to give any Inſtances of his* Philoſophical Sentiments, *ſince this whole* Work *contains nothing elſe, but his* Opinions, *or what may clearly and diſtinctly be deduced from them.*

SECTION III.

The Parts of *PHILOSOPHY*, and the Deſign of this whole Work.

Of the Parts of *PHILOSOPHY.* *PHILOSOPHY is commonly divided into* Three Parts, *viz. Firſt, Into METAPHYSICKS, or NATURAL THEOLOGY, which proves the* Being *of a* God, *or* Firſt Cauſe, *on whoſe exiſtence all* Truths *depend, and without the knowledge of whom no* Science *can be had. Secondly, Into PHYSIOLOGY, or NATURAL PHILOSOPHY, which comprehends the* Principles *of* Material Things, *conſiders the Original of the* World, *and enquires into the* Parts *whereof it doth conſiſt; and afterwards deſcends to conſider the* Form, *and* Qualifications *of the* Sun, Stars *and* Planets; *the* force *and* vertue *of the* Air, Water, Fire, Foſſils, *or things dug out of the* Earth, *as* Metals, &c. *And laſtly, Enquires into the* Nature *of* Plants *and* Animals, *and more eſpecially of* Man, *who is a Compendium of the* Univerſe; *and laſtly into MORAL PHILOSOPHY, or ETHICKS, which ſearches into the Nature of* Good; *diſcovers what* Manners *are honeſt and becoming, and directs and governs all our voluntary* Actions, *according to the* Rule *of* Right Reaſon. *But to the end that in the handling of* Philoſophy *the* Modus (*that is, the Natural Way and Order*) *of* Science *may be obſerved, I have rather thought fit to diſtinguiſh* Philoſophy *into* Ten Parts, *that by this* Diviſion *my* Diſcourſe *might be more* Methodical, *and avoid the* Confuſion *which is incident to the former* Partition.

LOGICK, the Firſt Part of *Philoſophy.* *I thought fit therefore to make LOGICK the Firſt Part of my* Diſcourſe, *it being the* Organ *or* Inſtrument *of all PHILOSOPHY, and very neceſſary to the attaining of all* Sciences. *Becauſe I never eſteemed any thing more valuable in* Man, *than a good* Mind *or*

Under-

Understanding, *whereby he is enabled to unfold the* Natures *of* Things, *and to discern* Truth *from* Falshood. *For all other* Gifts *of the* Mind *have their* Bounds, *and are only determin'd to some particular* Offices: *But the Rectitude of the* Understanding *is conducive to all the Uses of* Life; *and is not only profitable in the dispatch of* Business, *but for the attaining of* Arts *and* Sciences. *For this Reason it is that I have begun this* Philosophical Treatise *with* LOGICK, *which is the* Art *that Teaches the right use of* Reason, *and how* Man *ought to manage his* Thoughts *in the* knowing *and* judging *of* Things. *And forasmuch as the* Mind *of* Man *is subject to many* Errors, *and is biast for those* Opinions *it has embrac'd during* Childhood, *having premised something of the Usefulness of* LOGICK, *I take occasion to advise every one carefully to avoid the* Prejudices *of* Infancy, *and not to admit any thing for* Truth, *but what clear and distinct* Perception *hath manifested to be such. For he* judgeth *wrong who doth not give heed to his* Conceptions, *and compriseth more in the* Conclusion, *than he had perceived in the* Premisses.

For the avoiding of this Præcipitancy, *I first examin the* simple Terms *of* Things, *and briefly enumerate those* Notions *of which our* Thoughts *are compounded; afterwards I set down a* Scheme *of* Substance, *and its* Attributes, *by which it is more distinctly understood and distinguish'd from the* Modes *that belong to it. To this end it will be of great use attentively to consider the* Genealogy *of* Things *and* Modes; *as also the* Imposition, Signification, Definition *and* Use *of* Names. *But because it is not sufficient to have* Idea's *of* Things, *except we know also whether they be* simple, *or* resolvable *into other* Parts: *I have added the* Chapter *of* Definition *and* Division, *by which means all* Confusion *may be removed, and the* Nature *of every thing, and its* distinction *from others more clearly known.*

After the clear Perception *of* Things, *I come to the* Judgment *we are to make of every* Thing; *and in so doing, I proceed from* simple Things *to those that are* Compound, *and as it were from the first Step of* Logick *to the second. The Sum whereof is this, That in our search of* Truth, *we never give our* Assent *to any thing which doth not exactly answer to our* Perception: *For it is not enough that* Truth *be in this or the other thing, except the same do appear to us, and we be fully convinc'd of its Certainty. For I take him to know nothing at all, who relies only upon the* Authority *of others, and is led by their* Judgment, *without hearkning to his own.*

After this, I proceed to the Explication *of a* Syllogism, *which is made up of divers* Judgments *that are found of them. Now whether* Syllogisms *are of so great use towards the acquiring of* Sciences, *as in the* Schools *they are boasted to be, I dare not assert, seeing that the greatest part of those* Errors *Men fall into are much more caused by their using of* false Principles, *than by their not observing the* Rules *of* Good Reasoning. *However, they must be acknowledged to have their* Use, *as being very helpful for the exercise of* Wit, *and more especially for those, who through overmuch Subtilty, or want of due Attention, suffer themselves to be deceived by* false Consequences, *and to be led into* Error.

That which concludes this Part *of* PHILOSOPHY, *is* METHOD, *which is the chiefest Part of* Logick, *and without all Controversie the most useful. For it being that* Judgment *of the* Mind, *by means of which whatsoever belongs to a whole* Science *is fitly and rightly disposed and digested; it is extreamly conducive to the discovering any* Truths *we are ignorant of, or to the convincing of others of those we know already. This* Method *in particular is either* Genetical *or* Analytical, *in both which the true Practice of* Logick *is perfected.*

The Second Part, is of GOD.

But forasmuch as all our Knowledge *is uncertain, as long as the most* perfect Being, *from whom all others do proceed, is not known to exist; therefore I begin the* Second Part *of this* Treatise *with the* Existence of GOD. *This I evince from the* Idea *we have of him which represents a* Being absolutely perfect, wise, *and* powerful. *For 'tis a Contradiction, that that which includes all* Perfection *should not be necessarily* Existent, *seeing that* Existence *is a vow'd* Perfection, *which therefore can't be absent from a* Being *absolutely Perfect. And therefore as we clearly understand, that in the* Idea *of a* Triangle *is contain'd, that its* three Angles *are equal to* two right ones; *so we find, that in the* Conception *of* GOD *is involved Necessary and Eternal* Existence. *From hence we duly infer, that* GOD *is the* Creator *of all things, not only in respect of their* Existence, *but also of their* Essence: *So that even the* Propositions *of* Eternal Truth *do depend on this first* Truth, *and are no farther True than as they are determined thereby. The* Existence *of* GOD *being demonstrated* à priori, *I proceed to lay open his* Attributes, *which by necessary consequence follow from it; since it is impossible but the* supream Being *must include* Unity, Eternity, Omnipotence, Immensity, Beneficence, Providence, &c.

The Third Part; Of *Intelligences* and *Dæmons.*

Having thus examined the Nature *of* GOD, *and inquired into his* Perfections *according to the measure of our* weak Understanding, *the next in order to be considered, are the* INTELLIGENCES *and* DÆMONS, *whose* Existence, *as far as it can be reached by* Natural Light, *I have endeavoured to* demonstrate: *And afterwards proceeding to their* Faculties, *have shewed*

them to be endowed with Understanding *and* Will: *And because there is no small* Dispute *betwixt our* Divines *and the* Talmudists, *concerning their* Number, Distinction *and* Subordination, *I have barely set down their* Opinions *without adding any thing of my own. Thence I pass to the* Power *they have to assume* Bodies; *and add something concerning the Care and Concern they have for* Mankind, *which I briefly confirm from* Texts *of* Scripture *and* Reasons *deduced from their* Natures.

The Fourth Part; Of Natural Philosophy in general.

It being proved *that there is a GOD, by whose* Power *the* Angels *and all* Things *are produc'd, and that it is repugnant to his* Nature *to deceive us: We are sure that we can't be mistaken in those things which are clearly and distinctly known by us; and therefore seeing we have clear and distinct* Idea's *of* Bodily Things, *which we are not the Causes of, as being often represented to us whether we will or no; I thence infer, they must needs proceed from* Objects *without us, which really and actually exist in the* World. *For otherwise, if GOD should immediately impress such* Idea's *on our* Minds, *or cause them to be conveigh'd from* Objects *in which there was nothing of* Extension, Motion, *or* Figure, *it would follow that he did impose upon us; and therefore we must conclude, that there is a* Substance *extended in* length, breadth *and* depth, *or* thickness, *which we call* Body, *and is the* Object *of this* Fourth Part. *For all things that are handled in* Physiology *belong to* Body, *as its* Forms *or* Affections.

Let not any one wonder that I exclude all substantial Forms *from a* Body, *or extended* Matter, *since they are so obscure that they can't be explain'd, no nor so much as conceived by those very* Men *who are the great* Patrons *of them. Whereas on the other hand, nothing is more obvious and agreeable to our* Senses, *than to assign the* Effects *of* Nature *to the different* Magnitude, Figure, Position, Motion, *and the* Rest *of* Bodies. *Who is so stupid as not to apprehend these* Principles? *Is it not better to explain* Things *by* Causes *known and obvious to all, than to have recourse to some* Principles, *which none understand, and which are as dark and difficult to those that* teach, *as to those that* learn *them? It is folly to admit any thing in PHILOSOPHY which no Body could ever yet comprehend, no, nor I dare boldly say, ever will be comprehended.*

If we admit that Material Substance *consists in a Threefold* Dimension, *and that it can't be distinguished from* Extension, *save only by* Reason *or a* Mental separation; *it will be easie to demonstrate, that it is impossible for any* Vacuum *to be in* Nature: *That* Rarefaction *is only made by the intervening of* New Matter: *That the* World *is not circumscribed by any* Bounds: *That the* Internal place *of a* Body, *doth not at all differ from the* Body *it self; and that the* Heavenly Matter *is of the very same* Nature *with the* Inferior *and* Sublunary. *Forasmuch as that which the* Philosophers *call* Quantity, *is not the precise* extension *of the* Body, *but only its* extension *as such; that is, with respect to its being* commensurate *to such a number of* Inches, Feet, Yards, &c. *it being apparent that a* Body *retaining the self same* quantity, *may be further extended in* length *and* less *in* breadth, *or on the contrary. As* Matter *hath some* Essential properties, *viz.* Divisibility, Figure, Mensurability, *and* Impenetrability; *so likewise it has some* common Accidents, *viz.* Rarefaction, Local Motion, Heaviness, Lightness, Hardness, Softness, &c. *which are not in it, as so many distinct things; but only as* Modes, *which can't be separated from the* Body; *and if they could, they would be no longer called* Modes, *but* Substances, *whose peculiar* property *it is to exist by themselves, and independent of any* Subject. *And seeing that as all the diversification of* Matter, *or the variety of its* Forms, *depends on* Motion, *by which the* Matter *is divided into* Sensible *and* Insensible parts, *I clearly make out, that the* Three Elements *of the* World *had their rise thence. Then having shewed that a* Body *hath no* power *to* move *it self, I make it appear, that all those* Motions, *which by the* Peripateticks *are commonly* attributed *to the prevention of a* Vacuum, *are occasioned, because all* Motion *of* Bodies *is in a manner* circular, *one succeeding in the* place *of another. Then I proceed to the* determination *of* Motion, *whether* simple *or* compound, *treat of* Reflection *and* Refraction, *of the* Acting *and* Resisting power *in* Bodies, *and wherein it consists. Afterwards of the* state *of* Bodies, *as to their* Hardness, Fluidity, Rarity *or* Looseness of Parts, Closeness, Roughness *and* Smoothness, &c. *where I shew, that there are* Pores *as well in* fluid, *as in* hard Bodies; *and last of all give a hint, that the* Ends *of GOD are not to be searched into in* Physiology, *because it is an Argument of* Rashness *and* Arrogance. *And as for TIME, under which we consider the* Existence *of* Created things, *it is improperly said to be an* Affection *belonging to them, since indeed it is a meer* Mode *of* Thinking, *serving only to explain* Duration, *and distinguish the* Parts *of it.*

The Fifth Part; Of the *World* and *Heaven.*

Having thus laid those Foundations *of NATURAL PHILOSOPHY, I proceed to consider the* Unity *and* Perfection *of the* World, *and endeavour first to shew, that the* Creation *of it may be discovered by* Natural Reason: *That its* Extension *is* immense, *or rather* indetermin'd, *so as not to be* circumscribed *by any* Figure, *or* Bounds: *That the Matter of* Heavenly *and* Earthly Bodies *is one and the same; and enquire at large what is the* Form *of the* World,

whether

whether it be the Soul, *that is, the* Spirit *of* Nature, *or the beſt* diſpoſition *of* Parts: *And in the next place aſſert, That* GOD *hath communicated to the* Matter *whereof the* World *is made, a* determinate Meaſure *of* Motion, *and doth preſerve the ſame* quantity *in the ſame. Then paſs on to examine the* Action *of* Bodies, *and the* communication *of* Motion, *and add ſome* Rules *by which we may know, what muſt of neceſſity happen in the* meeting *of* Bodies. *Then follow the Three noted* Syſtems *of the* World, *viz. The* Ptolomaick, Tychonick, *and* Copernican, *and after having rejected the two former, I with* Deſcartes *embrace the latter, as being more ſimple and better agreeing with the ſeveral* Phænomena *of the* World. *Then ſhewing the* Heavens *to be* fluid, *I go on to Evidence how they were diſpoſed or rank'd at the beginning, and of what manner their* Motions *were, and what is the* Action *of the* Heavenly Matter. *And for a better underſtanding of the* Celeſtial Motions, *I deſcribe the* Heavenly Globe *with all its* Circles, *and their ſeveral* Uſes. *Then examin the* Nature *of the* Sun, *the* Adjuncts *of* Light *and* Luminoſity. *How* Spots *are* generated *about the* Sun *and the* fix'd Stars, *and vaniſh again. What* Comets *are, and how it comes to paſs that* fixed Stars *are changed into* Comets.

Next to the Comets *are the* Planets, *whoſe* riſe *is ſhewed, together with the* Principle *of their* Motion, *and how they become* Direct, Retrograde, *and* Stationary. *Then the* Moons motion *is conſidered, with its various* Appearances, *and the* Eclipſes *of it, as well as of the* Sun. *Next follows the* Nature *of the* fix'd Stars, *their* Number *and* Conſtellations, *and concerning their* Influences, *as well as of the other* Stars, *and what* Judgment *we are to make of* Judicial Aſtrology.

The Sixth Part; Concerning the Four Bodies.

Having thus taken ſome Turns in the Heavens, *we return again to the* Earth, *to take a more exact Account of its* Original parts *and* Figure, *and the manner of its being* moved *in the* fluid Heaven; *demonſtrate alſo its* Motion *by Reaſon, and Anſwer the* Objections *made againſt it; and then diſcover all the* Viciſſitudes *of* Night *and* Day, *and the ſeveral* Seaſons *of the* Year, *which proceed from the* Diurnal *and* Annual motion *of the* Earth. *Then take notice of the* Five Zones, *invented by* Geographers, *to diſtinguiſh the Variety of* Heat *and* Cold *in the ſeveral Parts of the* Earth, *occaſioned by the* nearneſs *or* diſtance *of the* Sun; *and the* Climates *made uſe of, for a more diſtinct* Explication *of the ſeveral* Tracts *and* Regions *of the* Earth. *Then proceed to the* diſcovery *of thoſe Things which are* generated *in the* Bowels *of the* Earth; *as* Fountains, Metals *and* Minerals, Stones, Gems, *the* Load-ſtone, *and* Electrical Bodies. *After, ſpeak of the* Water, *the* Flux *and* Reflux *of the* Sea: *Of the* Air, *and its* Elaſtick virtue. *Then of the* Meteors *in general, and particular; as of* Winds, Clouds, Miſts, Rain, Dew, Hoar-froſt, Cool *of the* Evening, Snow, Hail, Thunder, Lightning, Coruſcations, *the* Rain-Bow, Circles *formed about* Stars, *and* Mock-Suns. *Then unfold the* Nature *of* Fire, Heat *and* Cold: *The moſt remarkable* Effects *of* Fire, *as the Effervеſcence of ſome* Bodies, *and the Turning of others into a* Calx *or* Aſhes, Earthquakes, Fermentation, &c. *and laſt of all conſider the* Mixtion, Generation, Corruption, Alteration, Augmentation, *and* Diminution *of* Bodies.

The Seventh Part; Of Living Creatures.

Having thus largely enough handled (as I ſuppoſe) Inanimate things, *I proceed to thoſe that are* Living, *and having premiſed their* Diſtinction *from* Things *without* Life, *I aſſert their* Life *to conſiſt in a due Temperament of* Heat *and* Moiſture, *and conſequently that their* Death *proceeds from the contrary* Cauſes *of* Cold *and* Dryneſs. *Next I enquire into the* Cauſe *of the* Hardneſs *which is obſerved in the* Outſide *of them, and of the* difference *of this* Vital Heat *in* Living Creatures, *and why the ſame is weaker in ſome, and more ſtrong and durable in others. Then diſcover the* Nature *and* Virtue *of the* Aliment *or* Food *wherewith* Living Creatures *are Nouriſhed, and how* Living Things *come to be* changed *by the diverſity of* Place *and* Time; *and then come down to* Plants, *and having explained their Parts,* Original Nutrition, Growth, Difference *and* Propagation, *I enquire into the* Cauſes *of their different* Colour, Taſte *and* Smell; *as likewiſe of their* Periſhing *or* Death. *Laſtly, I lay open the* Nature *of* Animals, *what the* Souls *of* Beaſts *are, and then examin in particular the* Nature *of* Fourfooted Beaſts, Creeping Things, Birds, Fiſh *and* Inſects, *and wherein the* Death *of theſe conſiſts.*

The Eighth Part; Of *MAN.*

After having taken a View of this Great World, *I proceed to the Conſideration of the* Leſſer World *MAN, who may be defined a* Compound *of a* finite Mind, *and* rightly diſpoſed Body. *But foraſmuch as theſe* two Parts *are wholly of a diſtinct Nature, without any* Analogy *between them, I thought fitting to conſider them each apart, and handle them diſtinctly, that the ſeveral* Proprieties *of each might be the better known. Wherefore I ſet down the* deſcription *of the moſt principal* Parts *of* Mans Body, *both* Internal *and* External; *give an Account of the* Formation *of the* Birth *in the* Womb, *and of its* Animation; *as likewiſe of* Nutrition, *the* motion *of the* Heart, Arteries *and* Muſcles, *and of the* Circulation *of the* Blood. *Then follows* Reſpiration, *and how the ſame is performed in* Man; *and laſtly, ſome things are added of the* Increaſe *and* Decreaſe *of* Mans Body, *its* Temperaments, *and different* Ages. *And foraſmuch as the* Senſes *do chiefly belong to* Man, *I treat firſt of the* Senſes *in common, and ſhew that they are the Effect of*

the

the Nerves, *and that the* Soul *of* Man *feels only, foraſmuch as it reſides in the* Brain: *Then I ſpeak of the* Senſes *in particular*, viz. *of* Feeling, Taſting, Smelling, Hearing, *and laſtly having ſaid ſomething concerning the* Eye *and its* Object, *I Diſcourſe concerning* Sight, *the moſt Noble of all the* Senſes, *and of the* manner *how it is performed, and ſhew how the* Scituation, Diſtance, Magnitude *and* Figure *of* Bodies *are thereby diſcerned; and then add ſome* Chapters *of* Waking, Sleep *and* Dreams; *the* Appetite *of* Hunger *and* Thirſt; *of the* Common Senſe, Imagination *and* Memory; *of* Health *and* Sickneſs; *and laſtly, of* Medicaments *in general, and their* Operation.

The Ninth Part; Of the *Mind*, or *Soul* of Man.

I look upon the Rational Soul *as the Chief Part of* Man, *which excelleth the* Body *in its* Nature *and* Functions; *I evince that the ſame is more evidently perceived by us than the* Body, *ſince we cannot doubt of its* exiſtence *even at the very inſtant we are doubting of it: For it is a* Thinking Being, *not only* potentially, *as ſome conceive, but* actually; *becauſe* Thinking *can't be ſeparated from it without the* deſtruction *of its* Nature; *whence I* Argue, *that it is* eſſentially diſtinct *from* Material things, *which conſiſt in* extenſion, *and conſequently that it is* Spiritual *and* Immortal. *Now as to the* manner *of the Union of theſe* two Subſtances *in* Man, *I briefly aſſert, that the ſame conſiſts in this, that the* Functions *of the* Body *depend on the* Cogitations *of the* Mind, *and they again on the* Motions *of the* Body, *which* Miracle *is the work of the* All-wiſe *and* Omnipotent *GOD alone, as the* Immortality *and* Eternal duration *of the Soul is the effect of his* Good pleaſure. *I prove that there are* inborn Idea's *in the Mind of* Man, *eſpecially of GOD, a* Thing, Subſtance, general Maxims *of* Truth, Good, Equity, &c. *and explain the* four Faculties *of the* Mind *of* Man, *viz.* Underſtanding, Imagination, Will *and* Memory; *not as Things really diſtinct from it, but only as ſo many* Modes, *whereby it* Underſtands, Imagins, Wills *and* Remembers.

And becauſe the Affections *and* Paſſions *are the conſequence of the cloſe Union there is between the* Soul *and* Body, *I ſhall in the next place handle them, and endeavour to lay down in ſhort their* Nature, Cauſes *and* Effects; *and tho' there be many of them, and according to the variety of their* Objects, *are called by ſeveral* Names, *yet they have all of them but one and the ſame* common Principle, *to wit, the* Animal Spirits, *by the Motion whereof they are produced and ſtrengthned. For all of them* (*if we except* Admiration) *are conveighed to the* Brain, *and are always accompanied with a peculiar dilatation of the* Blood. *I enquire alſo in what part of the* Body *the* Soul *entertains its* Paſſions; *what* Love *is, what* Hatred, *what* Joy, *and what* Sorrow. *Laſtly, I undertake to aſſign the Cauſe of thoſe* Inclinations *which are peculiar to certain Perſons, and to which ſome give the Names of* Sympathy *and* Antipathy, *which I deduce from thoſe* Motions, *that by ſome external Cauſe are excited in the* Body *from its firſt* Infancy, *and are apt afterwards to awaken the ſame Thoughts in the* Soul; *as on the other hand likewiſe the ſame recurring Thoughts produce the ſame Motions in the* Body.

The Tenth and laſt Part; Concerning the right Conduct of *Life*.

Laſt of all, this PHILOSOPHY is concluded with a Diſcourſe of the right ordering and guidance of Life, *the* Happineſs *whereof doth not conſiſt in* Bodily pleaſures, *the* Goods *of* Fortune, *or the* Gifts *of the* Mind; *but in a firm* unſhaken purpoſe *and reſolution of* well-doing, *and in the* ſatisfaction *which thence ariſeth. And becauſe no Body can be ſaid to* do well, *but he that acts according to* Vertue, *I proceed to the Explication of VERTUE in general, and unfold its* Eſſence, *ſhewing that it doth not conſiſt in a* Mean *of the* Affections, *but in a* conſtant purſuit *of what ſeems beſt to* Right Reaſon; *and then paſs on to the ſeveral* Species *of it*, viz. Prudence, Temperance, Fortitude *and* Juſtice, *which are ſo many Foundations of* Human Happineſs. *I have not thought it any Crime in the handling of them, to depart from the received Cuſtom of the* Schools, *and to Exhort my* Readers *rather to* Doing *than* Talking, *as knowing that* Vertues *are not acquired by* Queſtions *or* Diviſions, *but by* Precepts *or* Rules *for the Forming of our* Manners. *I have alſo added ſome* Articles *concerning the* uſe *of the* Paſſions, *which I conceive to be of no ſmall Advantage to the obtaining of* Human Felicity, *as long as they continue under the Guidance of* Reaſon, *and without Tranſgreſſing any of its* Laws. *And foraſmuch as all* Vertue *would be in vain, in caſe* Man *were deprived of* Free-will, *I endeavour to prove, that* Man *was created Free by* God, *and that his* Præſcience *and* Power, *is no hindrance to* Human Liberty, *and that notwithſtanding the ſame, a Man may exert* Actions *worthy of* praiſe *or* reproach.

But becauſe theſe ETHICKS might appear defective without ſaying ſomething concerning Human Actions, *I thought fit to add a few things concerning the* Duties, *or* Offices *of* Man *in general, and of a* good Citizen *in particular; wherein I firſt* diſcourſe *largely enough concerning the* Rules *of* Human Actions, *whether they reſpect GOD, our SELVES, or our NEIGHBOUR, and tho' in theſe Three all* Human Obligations *ſeem to conſiſt, yet have I not thought much to ſuperadd to theſe ſome other* Laws *of* Humanity, *and* Rules *of* Covenants *and* Contracts, *whereby all* Perſons, *whether they be in a publick or private* Station, *may be informed what they are bound to do, and which be the* Offices *and* Duties *of* Human Life.

Altho'

Of the Means and Helps which conduce to *Philosophizing*.

Altho' throughout this whole Philosophical Work *I have endeavoured to observe a due Order, and to deduce subsequent* Truths *with all possible clearness from those that precede, yet I thought it would not be besides the Matter, if I should subjoyn some* Rules *for New Beginners in PHILOSOPHY to observe, in order to the Securing them from* Error, *and for the right conduct and guidance of their* Reason.

First Rule.

First RULE, That they lay aside all the Prejudices of their Infancy, *and admit nothing for* Truth, *which they have not first discust and examin'd anew.*

Second Rule.

Second RULE, That they be not rash in their Judgments, *but always abstain from* Judging, *as long as they have no clear and distinct* Perceptions; *and that they neither* affirm *or* deny *any thing, except it be of* Things *that are clearly and distinctly known by them.*

Third Rule.

Third RULE, That they give great heed to the Question *propounded, and warily consider, whether what they suppose themselves to have* perceived, *do necessarily follow from those* Truths, *which by a new Examination or Scrutiny they have found out.*

Fourth Rule.

Fourth RULE, To distribute the Difficulty *they undertake to Examin into so many* Parts, *as is fitting for the more easie and commodious* resolving *of it.*

Fifth Rule.

Fifth RULE, So to dispose the Members *of this* Division, *as to begin with those that are most* simple *and* easie *to be known; observing therein the Order of* Nature, *as far as may be, and so by degrees proceed to the* knowledge *of such as are more* difficult *and* compound.

Sixth Rule.

Sixth RULE, To examine all the Parts *singly by themselves, with so much Attention and Exactness, that they may be assured of having omitted none; and especially minding, whether they do not oppose and contradict those* first Truths *and* primitive Notions *they have already discovered, and clearly perceived.*

The Design of the *HISTORY of NATURE*.

Thus having gone through the Book *of the INSTITUTION, next follows the HISTORY OF NATURE. For seeing that the* Truth *of the* Principles *of any* Science *is made manifest by the Evidence of its* Deductions, *and that their* Certainty *is look'd upon as Indubitable, if those* Things *that are Inferr'd from them, do wholly depend upon the* knowledge *of them; I was desirous to try, whether the several* Appearances *of* Nature, *or all those* Things *which our* Senses *perceive to be in* Bodies, *did comport with the* Principles *laid in my INSTITUTION OF PHILOSOPHY, and whether there be such a Connection between them, as that tho' the* latter *may be Apprehended without the* former, *yet the* former *can never be Understood without the* latter.

For tho' the Principles *I make use of in the Explaining of* Things Natural *seem to be very plain, as being nothing else but the* Magnitude, Figure, Motion, Rest, *and* Position *of* Bodily Things; *nevertheless I dare affirm, that in this NATURAL HISTORY I have had recourse to no other* Principles; *and that I have not only explain'd all those* Effects, *which by the* Peripateticks *are commonly look'd upon as the* Miracles *of* Nature, *without the* Auxiliaries *of* Sympathy *and* Antipathy, *or the assistance of* occult Qualities; *but have also given a true and Natural* Reason *of them, so as to leave no room for* doubting *of their* Certainty, *especially if it be considered, how many* Things *concerning* Bodies, Qualities, Metals, Animals, &c. *are unfolded and cleared from so few and such simple* Principles, *which certainly could never so well cohere together, except they were* true, *and out of the reach of* doubting.

I confess I have chiefly taken upon me to explain the common Phœnomena, *and such as most frequently occur; yet must it not be thence inferr'd, that I can't with the same ease render a* Reason *of the more extraordinary, which do seldom happen; since the Cause of all* Effects *is alike, and forasmuch as whatsoever we meet with in the* World *hath its* Use *and* End *from the same* Principles. *Wherefore I have generally forbore mentioning such as those, lest I should seem to stand in need of* strange *and* uncommon things, *to demonstrate the* Certainty *of my* Principles, *or to have recourse to* Monsters *and* Prodigies *to be my* Witnesses *of their Evidence.*

My Design *therefore in this* Work *was, not to describe the whole HISTORY of NATURE, or to comprehend in One* Book *all the* Phœnomena *of the* Universe, *since that would be an infinite Task; but only to make out, that all the Things we see do perfectly well agree with the* Principles *I have establish'd in my INSTITUTION of PHILOSOPHY; and that nothing is handled by the* Philosophers *of any* Sects *whatsoever, which is not accommodately, yea, more distinctly and clearly explained by these* Principles.

The First Part is, Of the Nature of a BODY.

The First Part *therefore I begin with is the* Nature *of a BODY, and at the very beginning endeavour to prove against EPICURUS and the most Famous GASSENDUS, that there is no empty* Space *to be found between the* Parts *of* Matter: *That the* Arguments *and* Experiments *which they alledge for the proving of a* Vacuum *are to no purpose, and wrongly applied. And in the next place proceed to the* Affections *of* Bodies; *where, after I have asserted the indefinite* Divisibility *of a* Body, *I lay down several* Experiments *of* Bodies, Thin *and* Close, Hard *and* Fluid, Rough *and* Smooth, Transparent *and* Dark, Bended *and* Compress, *assigning the true Reason of their several* differences.

And

The Second Part is of *Qualities.*

And forasmuch as Qualities *do always accompany* Material Substance, *and affect and determine the same in whatsoever* State *the same may be*; *I was willing to demonstrate the* true Nature *of them by* Experiments, *shewing that they consist in* Quantity, Motion, Figure, *and* Position *of* Parts; *which afterwards I make manifest by the Examples of* Heat *and* Cold, Heaviness *and* Lightness; Taste, Smell, Sound, Colour *and other* Affections *of* Bodies *which strike our* Senses. *Which done, I discover those* Effects *which are commonly attributed to unknown* Qualities, *which they term* Occult, *and declare the* Causes *of them.*

The Third Part is, of the *World* and *Heaven.*

Afterwards I proceed to the History *of the* WORLD *and* HEAVEN, *taking my rise from the Beginning of the* World, *which is followed by the* Generation *of* Things, *and the Ordering of the several* Parts *of the* World, *with the end that threatens it from the* Generation *and* Corruption *of* Things: *After these come the* Phænomena *of the* HEAVEN, SUN, *and* FIXT STARS, *and the* Spots *that appear in their* Bodies: *And next to these the* PLANETS *and* COMETS: *And then from various* Examples *enquire, whether they have any* Power *upon us, or* Inferior Bodies, *or* Foretel *any thing with* Certainty, *and declare what we ought to judge of these kind of* Predictions.

The Fourth Part is, of the Four Bodies.

The Fourth Part *is taken up by the* Four great Bodies: *First, The* EARTH, *which is almost to be look'd upon as nothing, if compared with the* Universe: *Next, the* WATER, *with its various* Properties: *Then the* Rivers *and* Fountains, *whose* rise *is discovered; and after those the* Sea, *with the Cause of its* Ebbing *and* Flowing: *These being the* Things *that have not only troubled the Heads of the* Philosophers *of this* Age, *but also those of the* Ancients, *and forced them to betake their refuge to* occult Qualities. *Next to the* Water, *the* Phænomena *of the* FIRE *are discovered, the Effects whereof are very different, as* Earthquakes (*which don't affect the* whole Globe, *but only some part of it*) Glass *and* Coals, *which are produced by its* Operations; *and many other Things are Explained, not only of those which are* generated *here with us on the* Surface, *but also in the inward Parts of the* Earth. *And lastly, the* AIR *brings up the Rear of the* Elements, *whose* power *and* efficacy *appears as well in* Natural *as* Artificial Things.

The Fifth Part is, of *Fossils.*

And forasmuch as the Earth *doth hide many Things in its* Bowels, *which deserve our Consideration, I have added something concerning* FOSSILS, *viz.* Things *dug out of the* Earth *in* general: *And first of* Quicksilver, Brimstone, Salt, Gold, Silver, Tin, Lead, Brass, Iron, *and other* Minerals, *whose* Generation *is no less wonderful than their* Operations *and* Effects. *This done, I proceed to the* Stones, *and having discussed their various* generations, *I examine their* distinction *and different* Constitution: *And lastly, consider the* LOAD-STONE, *which tho' it be reckon'd amongst* common Stones, *and hath nothing of* lustre, *yet has very singular* effects, *and such as are astonishing to those, who do not own the* Striate *or* Screw-like Matter *to be the Cause of them.*

The Sixth Part is, of *Meteors.*

After this, I proceed to the discovering of the Phænomena *of* METEORS, *whose place as it is between the* Earth *and the* Stars, *so they seem to participate of both their* Natures. *First, I open the* Nature *of* Vapours *and* Exhalations, *and what goes to the* forming *of them: Then speak of the* WINDS, *which like* wandring Travellers *never rest. These are followed by* Rain, Hail, Snow, Dew *and* Honey; *and then I declare the* rise *and* effects *of* TEMPESTS *and* THUNDER; *also why* LIGHTNING *is so fierce, and why it seizeth* hard Bodies *without touching those that are* soft. *Amongst* Meteors, *the* RAINBOW *challengeth the first place, and other* Fires *kindled in the* Air, *which as they do more closely or loosly stick to their* Matter, *so they vanish sooner or later.*

The Seventh Part is, of *Plants.*

After these comes the Seventh Part, *concerning* PLANTS, *whose variety is almost infinite; where first I discourse of their* Parts, Virtues *and* Qualities, *whether hid or manifest, that are common to every* Plant. *Then I explain the* Sympathy *and* Antipathy *of some of them, adding something of their* rise, nutrition, germination *and* decay, *as much as may seem sufficient not only to understand their* Phænomena, *but also their whole* Nature.

The Eighth Part is, of *Animals.*

I begin my Treatise *of* ANIMALS *with those that are begot of themselves, or as others will have it,* begot *of* putrefaction, *and from them proceed to* Animals *that are produced from* Seed. *And having enquired into the Cause of* MONSTERS, *I speak concerning their different* Time *in bringing forth; and then passing over to their* Affections, *I search into the Causes of* HUNGER *and* THIRST, *and of the* CIRCULATION *of the* BLOOD; *and then consider what it is in them that is the* Principle *of such various* Operations, *and make out that they are performed in them* Mechanically, *without any* perception *or* knowledge; *why some of them* hate, *and others* love *one another; and lastly, why some* sleep *more, and others less; and why they are subject to different* Diseases.

The Ninth Part is, of *MAN.*

This whole History *is concluded with* MAN, *who in the becoming* Form *of his* Body *excells all other* Creatures *of the* World, *as well as he exceeds them by his* Reason, Understanding, *and his* Soul *or* Mind: *For tho' he makes use of the same* Organs *of the* Senses, *with other* Animals; *yet he doth not perceive the* Objects *of them as they do, since* Sensation *is a kind of* Cogitation *in him,*

him, which is not compatible to Brutes. *And thus having explained ſome* Experiments *concerning* Feeling, Taſting, Smelling, Hearing *and* Seeing; *I proceed to* Imagination *and* Memory, *and lay open the Cauſe of* Sleep *and* Dreams. *And laſtly, having deſcribed the Cauſes of* Paſſions *that outwardly appear, I Conclude this my* Natural Hiſtory, *with the peculiar* Natural propenſions *and* averſions *of ſome* Perſons, *the Original whereof tho' of long time hid, is now made plain and perſpicuous.*

The Deſign of the Diſcourſe, concerning the want of *Senſe* and *Knowledge* in *Beaſts.*

The Third *and* Laſt Book, *is of the want of SENSE and KNOWLEDGE in BEASTS; where, tho' from the Beginning of the* World *it hath been the Common received* Opinion, *that* Brute Beaſts *are endowed with* Senſe *and* Knowledge, *and conſequently that they are but gradually diſtinguiſh'd from* Men, *yet I make no ſcruple in this* Diſcourſe, *to deprive them of thoſe* Operations, *and to render them meer* Machins, *which by the furniture of* Organs *they are provided with, exert their ſeveral* Actions, *and perform all thoſe* wonderful things *which moſt* Men *think can't be done without* Knowledge. *For ſeeing that* Senſe *and* Knowledge *do include an immediate Conſciouſneſs of* Perceptions, *which it is Contradictory to ſuppoſe in the moſt* ſubtil *or* refin'd Body *that may be, I think that* Beaſts *ought to be deprived of them both, and that they are neither more nor leſs than meer* Engins *or* Machins. *But what will ſome ſay; Have not the* Beaſts *then any* Senſes *or* Appetites? *Yes, they have; but without* underſtanding *or* knowing *what they do ſo* feel *or* deſire: *For this is the peculiar Excellency of MAN, whereby he exceeds* Beaſts. *For in them is nothing to be met with beſides ſeveral* Motions, *which may as well be found in an* Artificial Machin, *as has been ſeen in the Flight of an* Artificial Fly, *and in that* Iron-Statue, *which after many* Turnings *and* Windings *preſented it ſelf before the* Emperour *of* Morocco, kneeled down, delivered a Petition, *and then* riſing again, *returned the* ſame way it came, *as* Hiſtorians *aſſure us. Accordingly it will appear, that all thoſe* Motions *which we perceive in* Beaſts, *are only determined by the* Animal Spirits, *with the help of the* Nerves *and* Muſcles, *and are performed in the ſame manner, as in us, when we do any thing without* minding *or* knowing *what we do: For indeed tho' ſuch* Actions *be done in us, yet they are not properly done by us; wherefore I allow no* Soul *in* Beaſts, *beſides the* Blood, *which being a* fluid Body, *and ſwiftly moved, its more* ſubtil part, *which we call* Spirit, *and continually is carried by* Arteries *to the* Brain, *and from thence into the* Nerves *and* Muſcles, *moves the whole* Body, *as I have fully here demonſtrated.*

This Work in all its Parts, more Compleat and Perfect than hitherto Publiſh'd.

Here is nothing more to be ſaid, unleſs it be to acquaint the Reader, *That tho' the* Three Treatiſes *contain'd in this* Volume, *have been well received in their former* Dreſſes, *both at* home *and* abroad, *having been often* Printed *here in* England *and in* Foreign Countries, *the laſt having been alſo* Tranſlated *into* French *by* Monſieur De VILLEMESMES, *then* Counſellor *to the preſent* French King. *Yet to make them more uſeful to all* Perſons, *I have now carefully* Reviewed, Altered, *and* Enlarged *them all; ſo that this whole* Work, *in all its* Parts, *is more Compleat and Perfect, than what has hitherto been Publiſhed in any* Language.

Anthony Le Grand.

THE

The PREFACE.

The Third and last Book, is of the nature of SENSE and KNOWLEDGE in BEASTS; the Difficulty of concerning the want of Sense and Knowledge in Beasts.

Here is nothing more to be said, unless it be to acquaint the Reader, That tho' the Three Treatises contain'd in this Volume, have been well received in their former Dresses, both at home and abroad, having been often Printed here in England and in Foreign Countries, the last having been all Translated into French by Monsieur De VILLEMESMES, then Counsellor to the present French King. Yet to make them more stylish to all Persons, I have more carefully Reviewed, Altered, and Enlarged them all; so that this whole Work, in all its Parts, is more Compleat and Perfect, than what has hitherto been Published in any Language.

This Work is all its Parts, more Compleat and Perfect than hitherto Publish'd.

Anthony Le Grand.

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An Explanation of the Sculptures in this Work.

First in the INSTITUTION *of* PHILOSOPHY

THE *Title*, represented by the *Figure* of *Fidelity*, sitting on a *Chair* ascended by three *Steps*, which Steps are Emblems of those three Parts of *Philosophy*, over which we must pass, before we can arrive at the perfection of *Truth*; her *Eagle* denotes her quick-sightedness, by which she is able to *read* the *Book*, held at that distance, *clare & distincte* (plainly and distinctly) as is therein written, whilst the *Sun* that seems to enlighten the *Book*, is an Emblem of that assistance *Heaven* freely affords us in our virtuous persuit of *Learning* and *Knowledge*: The *Figure* with its Foot on the first Step of the ascent, as likewise that with the *Globe*, and the other behind are Emblems of some *Proficients* in *Philosophy*, their particular progression in that noble Study being denoted by *precedency* of order.

In the *Preface*, the *Sculpture* represents the several *Pourtraitures* of those *Philosophers*, cited by the *Author* in his *prefatory Discourse*; those standing on the fore-ground, are *Descartes*, *Gassendus*, *Epicurus* and *Zeno*, the fittest to have the first place in this *Sculpture*, since by their *Works* they contributed most to the *building* this *Body* of *Philosophy*; which Emblem may likewise teach us not to be forgetful of those from whom we have received Benefits.

LOGICK, *Part* 1. *Chap.* 1. *fol.* 1. Represented by a *Woman* sitting in a Chair, holding in her Right Hand a two *pointed Sword*, and in her Left a *Serpent*, who *twists* about her *Arm*; on her *Head*, a *Helmet* surmounted by an *Eagle*; beneath her Feet are *Books*, *Swords* and *Garlands*, with *Boys*, having *Keys* and *Locks* in motion; at a distance two *Philosophers* discoursing: Her *Swords* are her most proper Emblems, *Logick* being *pugnatio Verborum* (a Word-fight); her *Snakes* denote her subtilty, her *Helmet* her strength, and her *Eagle* her discerning faculty; the *Locks* and *Keys* denote her power to lay open or conceal; the *Garlands* on the *Pedestals* of the *Pillars*, are the Trophies of her Victories gained over other parts of Learning, which Victory is represented by her having *Books*, *Swords* and *Garlands* laid at her Feet; the *Sword* occuping her Right Hand, and the *Snakes* her Left, denotes Powers, being nobler than cunning: The building in prospect, is the School of Learning dedicated to the Goddess *Minerva*.

LOGICK with *Truth* and *Falshood*, *Part* 1. *Chap.* 2. *fol.* 3. The *Figure* which seems just risen from her Chair is *Logick*, as appears by her usual Emblems, (treated of before) the *Figure* whom she seems to court, is *Truth*, represented with a *Glory* round her *Head*, having a loose *Garment* cast about her; the *Glory* denotes her Excellence, and her regardless *Robe* shews that *Truth* needs no Ornament, nor ought to be covered, tho' with the most pleasing and becoming pretences: The *Figure* next her, represents *Falshood*, being a *Syren* with a *Mask* and *Mirror*, the proper Emblems of that Vice, it being reported of that Creature, that she destroys with her Voice all that give ear to her; her *Mirror* denotes the double dealing of Falseness, and her *Mask* the disguises she is forced to make use of (for as it is said of *Virtue*, that could Men see her Naked, they would be most passionately enamoured of her,) so on the contrary, could they see *Falsity* undrest of her Masks and Disguises, they would flee from her, as the ugliest and most dangerous Monster. The Building behind, represents the Palace of *Logick*, being the School of Learning.

LOGICK discovering *Falshood*, *Part.* 1. *Chap.* 2. *Rule* 1. *fol.* 5. The representation of *Logick* as before, viewing intently the *Syren*, who has covered her Face with a Mask, under which appearance she endeavours to pass for *Truth*; but her lower parts being her badge of distinction, are uncovered by a little Boy, and so she is detected; which shews that the best maskt *Falshood* is discoverable by *Truth* and *Innocence*, tho' in its Childhood.

LOGICK embracing Truth, *Part* 1. *Chap.* 2. *Rule* 4. *fol.* 8. The *Sculpture* represents a *Garden*, in which the *Figure* of *Logick* appears together with *Truth*, both emblemis'd as before; the seeming Imbraces of *Logick* given to *Truth*, denote the acceptableneness of it to Learning; they being placed in a *Garden*, is to shew the Pleasures and Sweets that attend them both.

JUDGMENT, *Part.* 1. *Chap.* 11. *fol.* 26. Represented by an elderly *Man* sitting on a *Rainbow* in the *Clouds*, having *Books* and a Scrole of *Parchment* under his Left Foot, on his Right Knee a *Book* opened; the *Figure* standing by *Judgment*, is *Logick*, and points towards the opened *Book*: The Building is the prospect of a *Theatre*, the *Books* and *Serpents* under, are the Emblems of *Learning* and *Wisdom*, the inseparable Companions of *True Judgment*, who is represented elderly, as a Badge of Experience, and placed in the *Clouds* to shew his inspection of all Human Affairs; and the various Colours of the *Rainbow* he sits on, denote the various Methods he makes use of to be informed, and the brightness of its *Rays*, the clearness of his apprehension, and the seeming information given him by *Logicks*, pointing to the *Book*, shews the necessity of Learning, to enable us to make a true Judgment.

REASONING, *Part* 1. *Chap.* 15. *fol.* 33. Represented by an elderly *Woman*, sitting on a *Pedestal*, leaning her *Head* on her Left *Hand*, with *Books* under her Left Foot and Elbow, in her Right Hand a *Book* a little opened, her Forefinger therein, and a *Scrowl* hanging from below the *Book*, with this Motto, *in perfecto quiescit*; the *Figure*

ſtanding in a *Glory*, incircled with *Clouds*; and on which *Reaſoning* ſeems to have her Eye, repreſents *Truth* holding a *Book* in her Right Hand, and a Branch of *Palm* in her Left, having the *Globe* of the *Earth* under her Foot: On the Fore-ground are *Boys* and *Books*. The Motive for repreſenting *Reaſoning* by theſe *Figures*, are theſe, 'tis repreſented by a *Woman*, to denote its productive Faculty, right *Reaſoning* being the common *Mother* of every great *Good* and wiſe *Action*; the *Books* under her Foot, denote ſome doubts ſhe hath long ſince overcome; and thoſe under her Elbow, ſome doubts juſt removed; her melancholy *Poſture* and *Air*, ſhew the neceſſity of ſeriouſneſs in *Reaſoning*; the *Book* in her Right Hand, ſeems to contain (and more eſpecially that part which ſhe engageth with her Forefinger) what is expreſt in the *Scrole* that hangs from it, which is, that by the help of *Reaſoning* we may bring all our undertaking to that perfection as will afford the means of being at reſt: The placing *Truth*, as in the deſcription, is to ſhew, that *Reaſoning* hath always *Truth* in view, that being the End ſhe aimeth at; the *Glory* incircled with *Clouds*, expreſs the inward Beauties of *Truth*, tho' ſometime vail'd with *Clouds* of Ignorance; the *Book* and *Palm* which occupy her Hands, are Emblems of thoſe *Goods* ſhe gives her Poſſeſſors, Peace and Knowledge; and her Foot being placed upon the Terreſtrial *Globe*, denotes her excellence above all earthly things.

CONTEMPLATION Part 2. *Introduction, fol.* 53. The *Sculpture* repreſents a *Woman* kneeling at her Devotion, having beneath her the *Globe* of the *Earth*, with Eyes covered, holding a *Scepter* in her Right Hand, and on the ſame ſide, the *Sun* in *Glory*; and on her left ſide the *Moon* and *Stars*, which ſhe ſeems to inſpect with care; above in the *Clouds*, the *Glory* of the Supream *Deity*, with the word *Jehovah*, environ'd with Bleſſed *Spirits* in poſtures of *Adoration*: She is placed above the *World*, to ſhew that thoſe who ſeriouſly contemplate the *Glory* of *GOD*, muſt be contemners of the *World*, and have their Eyes, like hers, vail'd to all its Inducements, flattering Joys and Temptations; her *Scepter* denotes the power of heavenly Contemplation, we being thereby made more than *Kings* and *Conquerors* (according to the Scriptures;) her contemplating the *Sun*, *Moon* and *Stars*, ſhews that whoſoever ſoberly conſiders the wonderful Creation of thoſe *Glorious Bodies*, will think their time beſt imploy'd in contemplating with Gratitude and Wonder the Excellence and Power of that *GOD* who made them.

FATE and *WILL Part* 2. *Chap.* 5. *fol.* 62. The *Figure* on the Right Side with folded Hands, and clad in a full Garment, is *Fate*; his folded Hands are Emblems of Unchangableneſs, and his full Garment reſembles his Amplitude; the Golden Chain which ſeems to fall from the *Star* in Glory, on which *Fate* looks, and with which both he and the other *Figure* who repreſents *Will*, are incircled, ſhews the neceſſity of the *Wills* complying with *Fate*, being bound thereto with a Chain of Cœleſtial Cauſes; the Wings of *Will* are Emblems of her ſwiftneſs; and her extended and erected Hands and Head towards Heaven, ſhews we *will* every thing under the appearance of *Good*.

PROVIDENCE, Part 2. *Chap.* 16. *fol.* 74. Repreſented by a *Woman* ſitting on a Pedeſtal, her Right Arm leaning on a Wheat-ſheaf, and on her Left a Boy winged, bringing her a *Cornucopia* of Fruits and Flowers, as ſhewing the great *goodneſs* of *Providence*, who gives not only on the Right, Corn to ſupport the neceſſity of Nature, but alſo on the Left, Fruits and Flowers to recreate and cheriſh it: At a diſtance in proſpect is a Corn-field, in reaping time, brought to its maturity by that *Eye* of *Providence*, which from out of a *Glory* inſpects it, and thereby demonſtrates that *GOD* in his *Providence* vouchſafes to look down from his all *Glorious Throne* of *Heaven* to bleſs the *Goods* of the *Earth* to Mans uſe, which ought to draw from us returns of *Praiſe* and *Thanſgiving*.

SPIRITS, Part 3. *Introduction, fol.* 76. In the *Clouds* are repreſented *Choirs* of bleſſed *Angels* playing on *Muſical Inſtruments*, and *ſinging* and *praiſing GOD*. In a *Cavern* below, are repreſented the *Infernal Spirits*, ſeeming to utter hideous *Cries* and *Groans*, the effects of the anguiſh they ſuffer in themſelves, and that raiſed in them by their enviouſly beholding the happineſs of the *Bleſſed* above; for true Happineſs is by nothing ſo much expreſt as by *praiſing GOD*.

NATURE of ANGELS, Part 3. *Chap.* 1. *fol.* 77. In the *Clouds* appears a *glory* of *Angels* and *Cherubims* contemplating with *deſire* and *joy*, the Glory of *GOD* which appears above, half veild by a *dark Cloud*; it being the Nature not only of *Angels*, but of all good Men to behold with *Praiſes* and *Adoration* that *GOD* who made them for that end.

MOTION of ANGELS Part 3. *Chap.* 5. *fol.* 82. Repreſented by ſeveral *Angels*, occupying themſelves in doing the ſervice acceptable to their *Creator*, as bringing *Peace* and *Reward* to the *Good* on *Earth*, which is ſhewn by thoſe two, who bear a *Coronet* and *Branch* of *Palm* downwards, as likewiſe in carrying the *Actions* and *Prayers* of the *Juſt* to *Heaven*, ſhewn by that *Angel* who bears the *Pot* of *Incenſe* towards the *Sky*; and by the other who is uncovering the Monument of *King Charles* the Second, to lay, as it were, open the good *Actions* of that beſt of *Princes*, to that *GOD* who will reward them.

ORDER NUMBER and DISTINCTION of ANGELS, Part 3. *Chap.* 6. *fol.* 83. The *Sculpture* repreſents the three *Hierarchy* of *Angels*, and in each *Hierarchy* the three *Orders*; the *1ſt.* containing *Seraphims Cherubims* and *Thrones*, the *2d. Dominions, Virtues* and *Powers*; the *3d. Principalities*, *Arch-Angels*, and *Angels* with *Palms*, *Swords* and *Crowns*, denoting their *Offices* of *Peace*, *Power* and *Glory*, given them by that *GOD*, who is repreſented above them, and who made, ordered, numbred and diſtinguiſhed them for his *Service* and *Glory*.

DÆMONS, Part 3. *Chap.* 10. *fol.* 88. In a *gloomy Cavern* are repreſented the nine degrees of *Dæmons*, or *Infernal Spirits*, diſtinguiſhed by their monſtrous and ugly variety, and which (according to the Diſcourſe) they are known by: The firſt termed *Belzebub*, generally allowed Sovereign *Emperor* over all the reſt, tho' his Name ſignifies no more than *King* of *Flies*; the *2d. Python*, *3d. Belial*, *4th. Aſmodeus*, *5th. Satan*, *6th. Meririn*, *7th. Apolyon*, *8th. Aſtorath*, and *9th. Mammon*: The *Figures* in the *Air* are *Angels*, bearing up a *Child*

Child, whom they had reſcued from the *Devils*: The reaſon for the precedency of theſe *Devils* to one, the other ariſeth from their greater or leſſer power in doing hurt, and therefore ſome people may wonder why *Mammon*, who is taken for the *Devil* of *Riches*, ſhould be placed laſt, the power of *Gold* in doing ill being the greateſt.

CARE of ANGELS, *Part* 3. *Chap.* 11. *fol.* 89. Repreſented by an *Angel*, reſcuing and protecting a young Man from the fury of the *Devil*, and by two *Angels* driving a *Dæmon* before them, the defending us from the aſſaults and ſnares of the *Devil*, and driving him from us, being their conſtant *employment* and *care*.

PHISICKS, *Part* 4. *Chap.* 1. *fol.* 91. Repreſented by a *Woman* with a *Sphere* and *Books*; on her Right Side an *Eagle*, and on her Left two *Boys*, having a pair of *Compaſſes* and a *Square*; the three *Figures* in proſpect are three *Philoſophers* in conſultation concering the *Planets* and *Stars*, the *Books*, *Mathematical Inſtruments*, and *Eagle* are Emblems of the quickſightedneſs, Learning and Practice requiſit to the true underſtanding of *Phiſicks*.

DURATION and TIME, *Part* 4. *Chap.* 24. *fol.* 131. *Time* is repreſented by *Saturn*, being on Old Man bald Headed except one *Lock*, and ſtanding on Tiptoe with one Foot on a *Rock*, having a *Syth* and *Hourglaſs*: *Saturn* is feigned by the *Poets* to be the Father of the *Gods*, the firſt beginner of *Time*, his *Age* and *Bald-pate* denote his antiquity and duration, and his one *Lock*, the one *punctum* of *Time* preſent, by which we ought to hold; he ſtands on Tiptoe to ſhew he haſtens to be gon; his *Hourglaſs* and *Wings* are Emblems of his never reſting and ſwiftneſs, and the *Syth* the deſtruction and conſumption he makes of all things. The four *Figures* below him, repreſent the four *Seaſons* of the *Year* and parts of *Mans* Life, following one another towards the *Temple* of *Eternity*; our *Childhood* brings *Youth*, *Youth* brings *Manhood*, *Manhood Old Age*, and *Old Age* to that *Eternity* properly deſcribed by the Circle over the *Temple*, and the *Hoop* in the *Boys* Hand, being what are in appearance without end.

The Motion of the PLANETS, *Part* 5. *Chap.* 1. *fol.* 134. Repreſented by *Sybell*, having a *Caſtle* on her *Head*, and ſitting on *Lions*, placed on the *Globe* of the *Earth*; the *Caſtle* and *Lions* denote the ſtrength of the *Earth*, both in reſpect to its *Creatures* and *improvements*, the *Lion* being the ſtrongeſt *Animal* made by Nature, and a *Caſtle* the ſtrongeſt thing made by Art; her having the *Caſtle* on her Head, and the *Lions* below her, ſhew the ſtrength of *Human Art* is greater than the ſtrength of *Beaſts*; the ſeven other ſmall *Figures* are bodily repreſentations of thoſe *Poetical Heathen Gods*, whoſe Names are made uſe of to diſtinguiſh the *Planets* by; that in the midſt and over the *Earth*, is *Apollo*, encircled with Light, as *God* of the *Sun*; his *Bow* and *Arrow* denote the piercing power of his *Rays* and *Sun-beams*: That ſtanding on a *Cloud*, and under the *Earth*, is *Luna*; the *Bow* in her *Hand*, and *Creſſent* on her Head, are Badges of her two-fold *Devinity*; the firſt as ſhe is Goddeſs of *Hunters*, by the Name of *Diana*; the laſt as Goddeſs of the *Moon*, by the Name of *Luna*, as above: The *Figure* over *Apollo*, is *Mercury*, the Wings of his Feet denote his ſwiftneſs in running, as his Staff twiſted with *Snakes* doth his Cunning; thoſe being the peculiar Excellencies given him by the *Poets*, and the Qualifications that rendred him capaple of the great Employments he poſſeſſeth, of being Envoy and Currier in Ordinary to the *Gods*: The *Figure* on the Right Side of *Apollo*, is *Venus*, the *Star* on her Forehead denotes her *Divinity*; her *Doves* are Emblems of *Love*, and properly joined to her who is the *Goddeſs* of *Love*. Over *Mercury* ſtands *Mars*, who bears a *Sword* and *Buckler*, being accounted the *God* of *War*; that on the Left Hand is *Jupiter*, the *Thunderbolts* in his Hand, and the *Eagle* under him are the *Coat Armour* of *Heaven*, of which by the ſame Authority, he is accounted *God*: That on the Right Side is *Saturn*, his Wings denote the fleeting of *Time*, of which he is reported *God*, and the *Syth* in his Hand, ſhews the deſtruction made of all things by this Divinity *Time*.

The SUN in GLORY, *Part* 5. *Chap.* 14. *fol.* 157. Within a *Glory* is repreſented, *Phæbus* in his *Chariot* drawn by white *Horſes*, they being the *Creatures* he is ſaid to have ordered to be offered up to him in *Sacrifice*; beneath lies a *Shepherd* and his *Dog* a ſleeping, who are recovered from their drowſineſs by the brightneſs of his *Rays*, and the warmth of his *Beams*, which cheriſh and enliven all *Human Creatures*.

The MOON, *COMETS*, *&c.* *Part* 5. *Chap.* 17. *fol.* 162. The *Figure* covering his *Eye* with his *Finger*, is *Archimedes* a viewing the *Moon*, *Stars*, and other *Planets*, through a *Teliſcope*; and that *Figure* next him is a *Philoſopher* diſcourſing him about ſome *Planetary Obſervations*; upon and below the Table are ſeveral *Mathematical Inſtruments*, as *Squares*, *Globes*, *&c.*

The EARTH, *Part* 6. *Chap.* 1. *fol.* 179. Repreſented by *Sybell*, drawn by *Lions* in her *Charriot*, having a *Caſtle* on her Head, and the *Globe* of the *Earth* beneath her: The reaſon for repreſenting the *Earth* by this *Figure*, is given before in the Treatiſe of the Motion of the *Planets*: The *Angel* bearing *Fruits* and *Flowers*, as it were from *Earth* to *Heaven*, denotes that the ſweeteſt things of the *Earth* ought to be offered up to the *GOD* of *Heaven*, who made and preſerves the *Earth*.

DAY and NIGHT, *Part* 6. *Chap.* 5. *fol.* 187. The *Figure* of the *Young Man* with Wings holding a lighted *Torch* in his Right Hand, and a *Serpent* in a circular form in his Left, having one Foot on a *Cloud*, and the other on the light part of the *Globe*, repreſents *Day*; his Youth is the *Morning*, and his lighted Torch the *Noon*; his circular Serpent ſhews the motion of *Time*, and his treading on a *Cloud*, that he puts Darkneſs under his Feet; behind the *Globe* on the backſide, ſlipping away as it were, ſtands a *Woman* Winged and Cloathed in a a *Sables Garment*, embroidered with *Stars*, having on her Head a *Crown* of *Poppeys*, repreſenting *Night*; her Poſture ſhews her not to be able to ſtay in preſence of *Light*; her Garment is her proper Emblems, and her *Poppeys* are promoters of *Sleep*, the true buſineſs of the *Night*: The *Element* below her ſpangled with *Stars*, ſhews the deſcending of *Night* at the aſcending of *Day*.

The WATER, *Part.* 6. *Chap.* 11. *fol.* 202. Repreſented by *Thetis*, whom the *Poets* have fain'd to be Goddeſs of the *Sea*; her *Charriot* is drawn by *Dolphins*, accounted the beſt natured and moſt compaſſionate *Fiſh*; and for that reaſon preferred to the

honour

honour of drawing their *Queen*: Over her is the *Figure* of a *Boy*, who pours *Water* out of a *Watering pot*, as intimating that we have *Water* from above in *Rain*, as well as below in *Rivers*.

The AIR, *Part* 6. *Chap.* 13. *fol.* 207. Repreſented by the Goddeſs *Juno*, Wife of *Jupiter*, ſitting in a *Charriot* drawn by *Peacocks*; ſhe is accounted by the *Poets* as Goddeſs of the *Air*, and is drawn by theſe *Birds* as the moſt beautiful *Creatures*, to compleat whoſe beauty, ſhe hath adorned their *Tails* with a hundred refulgent *Eyes*, taken from *Argus*, to whom ſhe had given them, the better to ſee into the Amorous Intreagues of her Huſband *Jupiter*, of whom ſhe was Jealous, but *Argus* being kill'd by *Jupiter*, ſhe reaſſumed her Gift and diſpoſed of them as above.

The WIND, *Part* 6. *Chap.* 16. *fol.* 211. Repreſented by a *Figure* Crown'd and Sceptr'd, being *Æolus*, the *Poetical God*, and *King* of the *Winds*; on each ſide of him are two *Figures*, repreſenting the four *Winds*; the loweſt on the Right Hand is *Boreas*, the *North wind*, depicted like an *Old Man*, with *Bats Wings* and a *Serpents Tail*; his *Bats Wings* denote his blowing moſt in *Evenings* and *Nights*, and the *Serpents Tail* his ſtinging Colds and Blaſts; above is *Eurus* the *East-wind*, repreſented alſo by a *Man* with *Wings*, to ſhew the ſwiftneſs of his motion: The uppermoſt on the Left Hand is *Auſter*, the *South-wind*, repreſented by a *Young Man*, and below him *Zephyr*, the *Weſt-wind*, repreſented by a *Man* pouring out *Water*, as generally bringing *Rain* along with him; they are all blowing out *Winds*, which occaſions a *Tempeſt*, as appears by the foaming and raging Billows of the *Sea*, that ſeem to overwhelm the *Ships* therein.

THUNDER, *Part* 6. *Chap.* 19. *fol.* 217. Repreſented by *Jupiter*, who, as before is ſaid, is accounted the chief *God* of *Heaven*, and the Inventer and Uſer of *Thunderbolts*, having as 'tis ſtoried, been forc'd to contrive this *Weapon* to defend his Cœleſtial Kingdom againſt the aſſaults of the *Giants*, who dared to attempt the Invaſion of it; they are made by *Vulcan*, the Black-Smith in Ordinary to the *Gods*, and accounted as ſuch himſelf, and are of that ſubtile contrivance, that they at once *kill*, *burn* and *aſtoniſh* without being ſeen; for which reaſon there is no Guard to be made againſt them; he is ſet upon an *Eagle*, the Emblem of Quickſight and Power; for as that *Bird* only can gaze on the *Sun* with unmoved *Eyes*, and deſtroy with her *ſtrength* whom ſhe pleaſes of the *Birds*, ſo *Heaven* only has power to diſcern our *Actions*, and to puniſh where it thinks fit: The *Figures* below repreſent two *Men*, covering their Heads for fear of the *Thunder*, and affrighted at its noiſe; the *Houſes* on *Fire*, the *Trees Blaſted* and beaten down are the viſible effects of *Thunder*, and may admoniſh us to beware of offending *Heaven*, who can deſtroy with its Breath.

The FIRE, *Part* 6. *Chap.* 21. *fol.* 221. Repreſented by *Vulcan* ſtanding in his *Charriot*, which is drawn by *Sea-dogs*, at work at an *Anvil*, being furniſhed with Fire from *Mount Ætna*. *Vulcan* is the fam'd Blackſmith to the *Gods*, as is before ſaid, and conſequently a great Dealer in *Fire*; the two *Sea-Dogs* chained to, and drawing his *Charriot*, are Emblems of the predominancy that *Fire* hath over its contrary *Element* the *Water*; and by *Mount Ætna* is ſhewn the power of this hot *Element* even in the *Earth*.

ANIMALS in general, *Part* 7. *Introduction*, *fol.* 229. In the midſt a *Man* contemplating with admiration the variety of *Beaſts* and *Fowls* about him.

GARDNING, *Part* 7. *Chap.* 12. *fol.* 245. The repreſentation of a *Garden*, in which the four *Figures* are *Gardners*, imployed in ſo many ſeveral *Actions* belonging to that Ingenious Art, as *Digging*, *Grafting*, *Inoculating* and *Screening* of *Earth*; in proſpect a Fine Houſe.

ANIMALS, *Part* 7. *Chap.* 17. *fol.* 252. The repreſentation of ſeveral *Animals*, and more particularly thoſe extraordinary in their kind, as the *Horſe*, *Elephant*, *Lion*, *Camel*, *Deer*, *Bear*, *Swine*, *Sheep*, *Dog*, &c.

CREEPING THINGS, *Part* 7. *Chap* 19. *fol.* 256. Repreſented by a *Tortoiſe*, *Crocadile*, *Lyzard*, *Serpent*, *Mole*, &c.

FOWL or FLYING ANIMALS, *Part* 7. *Chap.* 20. *fol.* 257. Repreſented by the *Oſtridge*, *Eagle*, *Peacock*, *Swan*, *Turkey*, *Cock* and other *Birds*.

FISH or SWIMMING ANIMALS, *Part* 7. *Chap.* 21. *fol.* 259. Repreſented by the *Salmon*, *Pike*, *Lobſter*, and other Fiſh; in proſpect ſome Men in *Fiſhing Boats*, and *Nets* a catching *Fiſh*.

INSECTS, *Part* 7. *Chap.* 22. *fol.* 261. Repreſented by ſeveral ſorts of *Butterflies*, ſmall and great *Flies*, *Graſhoppers*, &c.

MAN as to his BODY, *Part* 8. *Chap.* 1. *fol.* 264. The *Figures* repreſent *Man* in his compleat *Body*, compoſed by *Bones*, *Fleſh* and *Skin*: That on a Pedeſtal on the Left, is perfect, the next is the *Muſcular*, having his *Skin* off, and the next an *Anatomy* of *Human Body*; the *Figures* ſeeming to inſpect them, repreſent *Phyſicians* as conſulting.

The five SENSES in general, *Part* 8. *Chap.* 10. *fol.* 283. 1*ſt*. *Smelling*, repreſented by the *Figure* holding a *Flower* to her Noſe. 2*d*. *Hearing*, repreſented by a Young *Woman* playing on an Inſtrument of Muſick. 3*d*. *Taſting*, repreſented by a Young *Woman* filling a Glaſs of Wine, and by her ſide a *Munkey* eating an Apple. 4*th*. *Feeling*, repreſented by a *Woman* pulling a *Snake* from her Hand, and by two *Cocks* fighting. 5*th*. *Seeing*, repreſented by a *Woman* in a Habit of a *Falconer*, having a *Hawk* on her Fiſt, ready to be caſt off at that *Bird* in the *Air* which the ſeems to view.

FEELING, *Part* 8. *Chap.* 12. *fol.* 286. Repreſented by a *Woman* ſeeming to ſnatch her Hand from a *Parrot*, who ſeems to bite it; at the ſame time a *Dog* is pulling her by the Coat; as alſo by that feeling ſtory of the *Monkey* making uſe of the *Cats* Paw to pull the Cheſnut out of the Fire; and by a *Mans* beating a *Dog*, and by the fighting of two *Birds*, all true Emblems of this noble *Senſe*.

TASTING, *Part* 8. *Chap.* 13. *fol.* 288. Repreſented by two *Women* in a Garden, the one ſeated and eating an *Orange*, expreſſing by her gay *Air* the pleaſure afforded her by that noble *Senſe*; the other is the *Figure* of a *Woman* pulling ſome Fruit in order to eat it; there are alſo *Cupids* eating *Oranges*, to ſhew the pleaſures of Love conſiſt chiefly in *Taſting*.

SMELLING, *Part* 8. *Chap.* 14. *fol.* 290. Repreſented by two *Women* in a Flower Garden, and ſmelling the Flowers: By a *Blood-hound* in Scent after his Game; as likewiſe by an *Incenſe Pot* ſmoaking with Perfumes, being the moſt pregnant Emblems of that *Senſe*.

HEARING, *Part* 8. *Chap.* 15. *fol.* 292. Re-

Repreſented by a *Woman* playing on an *Organ*, having two Women ſtanding behind her, with *Muſick-Books* in their Hands, and ſeeming to ſing in conſort; and by a *Cock* pearching on a *Pedeſtal*, being the Creature who hears at a greater diſtance than any other.

SEEING, Part 8. *Chap.* 18. *fol.* 297. Repreſented by a *Man* with a Proſpective in his Hand, ſtanding on a Hill viewing an Ingagement of *Ships* at ſome diſtance, and by a *Figure* lying on the fore-ground, having his Eyes fixt on the *Sea*, which ſeems at a diſtance.

MEDICIN, Part 8. *Chap.* 24. *fol.* 315. Repreſented by the Serpent *Python*, ſurmounted by *Apollo*, the God of the *Sun*. This Serpent is ſaid to *Poiſon* all the *Herbs* and *Graſs* he comes near, and for that reaſon was deſtroyed by *Apollo*, who alſo is the God of *Wiſdom*, and properly Emblemiſeth *Medicin*, there being, in wiſely prepared *Medicins*, a remedy to deſtroy all poiſonous Diſeaſes.

MAN as to his MIND, Part 9. *Chap.* 1. *fol.* 320. The Womaniſh *Figure* holding a *Sphere* in her Right Hand, and a *Glory* deſcending from *Heaven* upon her Head, repreſents a *Human Soul*; the *Sphere* is the Emblem of its *knowledge*, as to *Human Affairs*, the deſcending *Glory*, its Immortality; on her Right Hand ſtands *Knowledge*, repreſented by a *VVoman*, who holds a Torch lighted in her Right Hand, an open *Book* on her *Lap*; and on the Left Hand is the *Figure* of a *Man*, ſitting in a muſing poſture, having Wings on his Back, and repreſents *Thought*; ſhe is thus attended to ſhew that the two nobleſt *Faculties* of the *Soul* are *Knowledge* and *Thinking*.

The FACULTIES of the MIND, Part 9. *Chap.* 5. *fol.* 328. The four *Figures* repreſent the four *Faculties*. *1ſt. Underſtanding*, repreſented by a *Young Man*, to denote the Beauty of it, Robed and Crown'd to ſhew that *Honour* and *Power* attend it; and the Flame encircling the Head, is an Emblem of its alliance to *Heaven*, and the *Eagle* is an Emblem of its quickneſs in perceiving. *2d.* On the Right Hand of *Underſtanding* ſtands *Imagination* repreſented by a *Woman*, to ſhew its productive Power, which is alſo ſhewn by the *Coronet* of ſmall *Figures* ſhe bears on her *Head*; *Imagination* producing more various forms and beings than *Dame Nature* can boaſt of; the Wings on her *Head* denote the ſwiftneſs of that Faculty. The *3d.* is *Memory*, repreſented by a *Woman* with a *Helmet* on her Head, to ſhew the ſtrength of that Faculty; and by her a *Dog* in a Slip; a *Dog* is a proper Emblem of *Memory*, enjoying, as by Experience is found, more than any other Creature, of that noble Faculty. The *4th.* is *Will*, repreſented by a *Young Man* Wing'd and Blindfolded with extended *Arms*, and erected *Head*; the reaſon for repreſenting that Faculty is given before.

ADMIRATION, Part 9. *Chap.* 9. *fol.* 335. Repreſented by a *Woman*, ſeeming to have all her *Faculties* at work, by viewing that admirable Object that lies before her, being a *Lion* and a *Lamb* lovingly enfolded, and by other *Figures*, whoſe Looks ſpake this Paſſion; in proſpect, a Building.

LOVE and Hatred, Part 9. *Chap.* 10. *fol.* 337. Repreſented by *Venus* the Goddeſs of *Love*, ſitting in the *Clouds*, and over her *Cupid* her *Son* and *Meſſenger*; the *Arrow* he holds in his *Hand*, is the *Weapon* that opened the way for the *love* of the Man below, to the *Heart* of that *Lady*, who ſeems to embrace him: The *Figure*, as it were ſtabbing the other with a *Dagger*, repreſents *Hatred*, and the *Devil* behind him ſhews the ugly and damnable qualities of that Vice.

AFFECTIONS or DESIRE, Part 9. *Chap.* 11. *fol.* 338. Repreſented by a *Young Woman*, who in the purſuit of *Honour* and *Riches*, which ſeem to appear to her at a diſtance, is thrown down by the *Figure* of *Will*, (repreſented as uſually) and at the ſame time a *Serpent* bites her by the *Heel*, ſhewing the miſery and pain which attend the deſiring or affecting too much above what we want, to ſuſtain Nature, and the Precipice we are hurl'd from by our *Will*, in placing our *Affections* on thoſe *Goods* of *Fortune* which are not in our reach.

JOY, Part 9. *Chap.* 12. *fol.* 339. Repreſented by a *Young Woman*, in a looſe Garment, having a Bottle of *Wine* in one Hand, and a Glaſs in the other; by her another *Figure* with a Bottle, and on the fore-ground *Boys* playing on *Flutes*: This Paſſion is moſt properly thus emblemiſed, *Women*, *Wine*, and *Muſick* being the Joy *Heaven* gave us to guild this otherwiſe bitter Pill of Life.

SADNESS, Part 9. *Chap.* 13. *fol.* 340. Repreſented by a *Woman* in a *Widows* habit, ſitting on the *ground* in a *melancholy poſture*, leaning her *Head* on her *Hand*; by her a *Boy* a weeping, and below her a *Boy* with an extinguiſhed *Torch*; above, and at ſome diſtance from her, ſtands an *Urn* impaled with *Cyprus Trees*; upon the *Rails* which encompaſs the *Pedeſtal* of the *Urn*, ſtand *Pots* of *Fire* flaming, to the *memory* of him whoſe *aſhes* are contained therein: Theſe *Figures* are the propereſt Emblems of this Paſſion of *Sorrow*, no ſtate being ſo void of *Joy* as hers, who being a fond and virtuous *Wife*, is by death robbed of a deſerving tender *Husband*; the darkn'd *Torch* held near her, ſhews ſhe has no flame, but that which burns to the *Manes* of her departed *Lord*.

ETHICKS, to front Part 10. *fol.* 346. Repreſented by a *Woman*, ſeated in a graceful Poſture on an aſcent, holding a *Lion* bridled in her Left Hand, and in her Right a *Level*; her aſcent and graceful Poſture, ſhew the Majeſty of this Noble part of *Philoſophy*; her bridled *Lion* denote its Power; the force of her Arguments in evincing and clearing, are ſhewn by her *Level*: On her Right Side are the three Cardinal Virtues, *Truth*, *Juſtice* and *Charity*; the firſt repreſented by a naked *Figure*, holding a *Book* and *Palm Branch* in one Hand, and the *Sun* in the other: 'Tis naked, to ſhew *Truth* ought not to be covered; her *Book* and *Palm* are the rewards ſhe gives, which are *Peace and Knowledge*; and the *Sun* is an Emblem of her Brightneſs, *Truth* being as clear as the Noon Day: The *2d.* is repreſented by the *Figure* of a *Woman* vailed, holding a *Scepter*, with an *Eye* upon the top, in her Hand; ſhe is veiled, to ſhew ſhe looketh not on, nor regardeth the Perſon of any, but adminiſters *Juſtice* impartially; her *Scepter* and *Eye* denote her Power and Knowledge: The next is *Charity*, repreſented by a *Woman* comforting *Children*; on the Left Side of *Ethicks* ſtand the four Vices, *Envy*, *Drunkenneſs*, *Laſciviouſneſs* and *Deceit*. The *1ſt. Envy*, is repreſented by an *Old Woman* half naked, having *Snakes* about her Body and Hair; *Age* and *Snakes* are the proper Emblems of this *Vice*, it being as old as the *Devil*, and poyſoning the *Minds* of all that entertain it, as *Snakes* do the Bodies of all that touch 'em. The *2d. Drunkenneſs* is repreſented by a *Man* a *ſpewing*, the true loathſom Emblem of that *Gluttonous Vice*. *3d. Laſciviouſneſs* repreſented by a *Woman* in an immodeſt poſture, that being *Laſciviouſneſs*. *4th. Deceit*, repreſented by a *Woman* holding a Mask, ſhewing the neceſſity that *Vice* hath of being diſguiſed, and of its often appearing under borrowed forms: *Ethicks* is thus attended to ſhew the *Virtues* ſhe poſſeſſeth, and the *Vices* ſhe hath overcome.

The HIGHEST GOOD, Part 10. *Chap.* 3. *fol.* 350. Repreſented by a *Young Man*, cloathed in a ſhort Garment, with his *Eyes* lift up towards *Heaven*, holding in one Hand an *Olive Branch*, and in the other a *burning Heart*, into which his *Tears* ſeem to fall, and on his

Head the *Glory* of *Heaven* descending, as through a *Cloud*: The highest *Good* consists in these three things, peace of *Mind*, the favour of *God*, and a Heart *flaming* with desire of *Heavenly things*; and therefore 'tis properly represented by this *Figure*.

The LAW of NATURE, Part 10. *Chap.*8. *fol.*356. Represented by a *Young Woman* half naked, having her lower parts covered with a *Lamb-skin*, Emblems of that innocence and modesty prescribed by *Natures Law*; she is placed in a pleasant *Garden*, holding a Table on her Knee, and a pair of Compasses in her Hand, measuring two *parallels*, with this Motto *Æqua lance*; behind her a *Woman* holding *Books*, and having other *Books* under her Feet; all which denote how even just and pleasant the Laws of *Nature* are: On her Right Side are the three *Virtues*, *Truth*, *Justice* and *Charity*; and on her Left Side, *Envy*, *Drunkenness*, *Malice* and *Pride*, all properly Emblematis'd as before; by the *Virtues* being on the Right of *Nature*, and the *Vices* on the Left, we are taught that *Virtue* is more acceptable than *Vice* to Nature in her first *Principles*, till she is dabaucht by Custom or Practise.

PRUDENCE, Part 10. *Chap.* 9. *fol.* 359. Represented by a *Woman*, standing in a graceful posture, holding in her Right Hand a *Looking-glass*, and in her Left a *Serpent*; and over her an *Angel* putting an *Helmet* on her Head; on her Right Hand a *Cupid*, holding an *Olive Branch* in one Hand, and a *Palm* in the other; and on her Left Side a *Young Man* with a *Sword* and *Buckler*: The *Looking-glass* in her Right, denotes that every prudent *Person* ought to look into, and know themselves; the *Serpent* is an Emblem of Cunning, and the *Angel* putting the *Helmet* on her Head, expresseth *Heavens aiding* us in all our prudent undertaking: The *Cupid* with Branches, and the *Young Man* Armed, denote that Prudence brings success in *Love*, and Victory in War.

TEMPERANCE, Part 10. *Chap.*10. *fol.*361. Represented by a *VVoman*, holding in her Right hand a Bridle to curb the exorbitant desires of the Flesh, and over her Head an *Angel*, crowning her with *Lawrels*, having a *Palm* in his Hand, thereby shewing that *Heaven* will reward this *Virtue* with *Peace* and *Glory*; on her Right a *Cupid*, pouring out *liquor* in a *Vessel*, and on her Left an *Elephant*, dividing his proportion of *Corn*, denoting thereby that we must use *Temperance* even in *Love*, and that *Beasts* share in that *Virtue* which men must blush to want.

FORTITUDE, Part 10. *Chap.*11. *fol.*363. Represented by a *VVoman*, holding a *Pillar*, and curbing with a *Bridle* a *Lion*, who seems inraged: In the *Air* is represented *Hercules* with his *Club* and *Lions Skin*; the story of *Hercules*, and the reason for his being so adorn'd is so little estranged, that it needs not be here repeated, therefore I shall only add, that the Emblems of *Corporal Fortitude*, as here described, serve only to enable us to judge of the greater *fortitudes* of the Mind discourst of in the Book.

JUSTICE, Part 10. *Chap.* 12. *fol.* 365. Represented by a *VVoman*, holding in her Right Hand a *Sword*, and in her Left a pair of *Scales*; next her a *Boy* bearing the *Fasces* and *Axes* carrying before the *Roman* Victors: The *Figures* of the *Men* represent *Philosophers* contemplating *Justice*, that being the *work* of every wise *Man*; the *Fasces* were *Rods*, with which they used to *chastise Malefactors* for small faults.

MANS DUTY to GOD, Part 10. *Chap.* 23. *fol.*382. Represented by a *Man*, *VVoman* and *Boy*, addressing themselves to *Heaven*, in a becoming posture, and in the *Clouds* two *Angels* with *Trumpets*; 'tis represented by these three, to shew that *Men*, *VVomen* and *Children* are obliged to this Duty; the *Angels* with *Trumpets*, denote the joy the Blessed have in beholding the Righteous Actions of *Men*; the *Angel* below pointing to the *Coronet* and *Cornucopia*, is an Emblem of that *Honour* promised to the Righteous; the Flame three-fold, flaming on the *Womans* Head, denotes by its number the *Trinity*, by its heat, the warmth of her Zeal, and by its light, the brightness of her Faith.

MANS DUTY to HIMSELF, Part 10. *Chap.*24. *fol.* 384. Represented by an *Old Man*, in a becoming posture, holding in his Right Hand a *Staff*, having a *Serpent* twisted about it, his Head Crowned with *Lawrel*; on his Right Side a *Young Man* armed, having on his Head a *Helmet*, in his Right Hand a *Sword*, and in his Left a *Target*; self-preservation is every Mans duty to himself, and therefore provident Nature hath furnish'd the means; to the Old she hath given Cunning to save themselves, emblematis'd by the *Old Mans Staff*, encircled with *Serpents*, the cunningest and most subtile of *Creatures*; to the *Young*, *strength* and *valour*, represented by the *Sword* and *Target*, held in the Young Mans Hand, whilst the *Figure* of *Justice*, who stands before them both, informs us that both Old and Young are obliged to be just, not only to others, but to themselves.

MANS DUTY to his NEIGHBOUR, Part. 10. *Chap.*25. *fol* 385. Represented by two *Men* kindly embracing each other; on their Right Side are *Justice*, *Love* and *Charity*, with their proper Emblems as before described; and on their Left, a *Woman* with a *Cornucopia* of *Fruits* and *Flowers*, the Emblem of *Plenty*; all which denote, that we ought to be friendly in our *carriage*, just in our *dealings*, and charitable (according to our ability, to all that want) and that those who do so, shall have plenty of all the *Fruits* of the *Earth*.

CONTRACTS, Part 10. *Chap.* 27. *fol.*387. Represented by the Platform of a *Custom-house Key*, with *Figures* of several Men, denoting a *Merchant*, a *Chapman* and *Porter*; in a *Barge* a Man stowing some goods, which they seem to have contracted for.

MUTUAL FAITH or MARRIAGE, Part 10. *Chap.* 32. *fol.* 395. Represented by the *Figure* of *Faith*, being a *Woman* almost naked, having a *Glory* about her Head; her nakedness denotes her *innocence*, and the *Glory* is the Emblem of that *Heaven* from whence she sprung; she is placed between a *Man* and *Woman*, joining Hands as in Marriage, to shew that she only can truly perform that *Office*: On the *Mans* side is the *Figure* of *Justice*, an emblem of what he owes to his *Wife*; and on the *Womans*, that of *Constancy*, and a *Cupid* with a lighted *Torch*, denoting that the Duties of a Wife to her Husband are constant Love and Desire towards him; the *Torch* is a Badge of the ancient way of performing that Ceremony of *Marriage*, for on the *Wedding-day* they used to light up a considerable number of them, in honour to *Hymen* the God of *Marriage*; the billing *Turtles* are emblems of that *Love* and *Harmony* which ought to be between *Man* and *Woman*.

DUTY of PARENTS and CHILDREN, Part 10. *Chap.* 33. *fol.* 396. Represented by a *Man* and *Woman*, sitting in a grave and loving posture, having *Children* about them; by their side is the *Figure* of *Justice*, having her Head covered with a *Helmet*, and a *Mound* under her Foot, to denote that the Duty of *Parents* is giving good example to their *Children*, and that their *Justice* ought to take place and surmount all *paternal fondness*; on the Right Side is the *Figure* of a *Woman veil'd*, representing the modesty *Children* must observe in the presence of their *Parents*; the *Stork* by her Side is the emblem of ill *Parents*, it being reported of that *Bird*, that she eats her Young Ones.

DUTY of MASTERS and SERVANTS, Part 10. *Chap.*

Chap. 34. *fol.* 397. Represented by a *Woman*, sitting in a graceful posture in a *Chair*, attended on the Right Hand by a *Woman* holding a *Garland* and *Cornucopia*, representing *Plenty*; and on the Left by a *Woman*, bearing a *Sword* and *Ballance*, the emblem of *Justice*; before the *Chair* stands a *Blackamoor* Lackquey, seeming to receive some *Errant* to go on; beneath the *Figure* of *Plenty* stands a *Maidservant* attending her *Ladies* Commands, all which properly describe that *Masters* and *Mistresses* are bound in duty to do *Justice* to, and provide for their *Servants* plenty, and that the duty of *Servants* is the careful, honest and respectful performance of all their *Masters* or *Mistresses* lawful Commands.

REGAL POWER, *Part* 10. *Chap.* 35. *fol.* 398. Represented by a *Man*, seated on a *Throne*, *Crown'd*, *Rob'd*, *Scepter'd*, with a *Mound* in his Left Hand, attended on by his *Courtiers*, as also by the representations of *Justice*, *Prudence*, *Clemency*, *Fortitude* and *Truth*, as the eternal *Companions* of true *Regal Power*; he being no more properly a *King*, who wants these *Virtues*, than an illiterate *Man* can be a *Judge* of *Learning*.

The Explanation of the Sculptures in the HISTORY *of* NATURE, *Book II.*

THE *FRONTICEPIECE*, represented by a *Woman* looking behind her, and *writing* in a *Book*, which lies on the Back of *Time*, emblematis'd as before; shewing the nature of History, which is the immediate representation of things past; and by another *Figure* reviewing the *Sun*, *Moon*, *Stars*, &c. and surrounded with several *Beasts*, *Birds*, &c. denoting the generality of things treated of by *History*.

No VACUUM, *Part* 1. *Chap.* 1, 2, 3. *fol.* 1. The *Author* having proved it in his *Book*, 'tis thus represented by the *Sculpture*, a *Boy* pouring *Liquor* out of one *Vessel* into another, thereby shewing, that as the *Air* which occupied the lower *Vessel* is drove out by the heavier *Element* of *Water*, it immediately enters into, and fills the upper *Vessel*; as also by the blowing up of a *Mine*, the visible effects of the extension and dilatation of *Air*: The *Figures* seeming to discourse, represents *Philosophers*.

SMELLING, *Part* 2. *Chap.* 6. *fol* 35. Represented by a *Blood-hound* in *scent* after his *Game*; by a *Woman smelling* to a *Nosegay*; by a *Man* who seems offended at some unpleasing *smell*; and by a *Woman* in a *swoon*, supported by two others, and one of them holding a *Box* or *Glass* of some *Scent* to her *Nose*, which seems to recover her: In prospect a *Pack* of *Hounds* in chase of a *Fox*.

SOUND, *Part* 2. *Chap.* 7. *fol.* 38. Represented by several *Musical Instruments* lying on the fore-ground; also by a *Man* ringing a *Bell*, by another sounding a *Trumpet*, by another beating a *Kettle-Drum*, and by a *Woman* tinkling on a *Brass Vessel* to a swarm of *Bees* to hive them, all proper emblems of *Sound*.

OCCULT QUALITIES, *Part* 2. *Chap.* 10. *fol.* 50. Represented by a *Man*, seemingly trembling at the sight of a *Lion*, and hastily running from it; by the terror of a *Sheep* at the sight of a *Wolf*; by the seeming trembling and fear of a *Hen* and *Chickens* at the sight of a *Kite*, and by the hasty flight of a *Dove* from a *Hawk*; all the visible effects of qualities proceeding from a Cause admired, but never known.

The BEGINNING or INFANCY of the WORLD, *Part* 3. *Chap.* 1. *fol.* 54. Represented by the *Figures* of a *Savage Man*, *Woman* and *Children*, who seem to live in those *Huts* placed in the *Woods*, having several *Animals* about them. The Primitive Times supposed to want the conveniencies of *Houses* and *Apparel*, through want of experience.

The SUN, *Part* 3. *Chap.* 6. *fol.* 62. Represented by *Phœbus*, sitting in his *Charriot* in the *Clouds*, drawn by four white *Horses*, for the reasons before given in the description of the *Sun* in *Glory*. The *Figures* on the lower part are representations of several *Men*, *Women* and *Animals*, bathing themselves (as it were) in those brilliant Rays proceeding from this warm *Deity*, *Phœbus*, and may teach us how pleasant and joyful it is to live in the *Sunshine* of *Heaven*.

The MOON, *Part* 3. *Chap.* 8. *fol.* 67. Represented by the Goddess *Diana*, she having a Sovereignity of this seeming Ball of *Fire*, given her by the *Poets*: At her Back are *Dogs* pursuing a *Stag*, the emblem of *Hunting*, of which she is, by the same Authority, Goddess; and underneath is a Landskip with *Deer* therein, the *Victims* offered up to her *Divine Recreation*.

The PLANETS, *Part* 3. *Chap.* 9. *fol.* 70. Represented by the Personal *Figures* of those *Heathen Deities* from whom they borrow their *Names*. As *Luna*, *Mercury*, *Venus*, *Apollo*, *Mars*, *Jupiter*, and *Saturn*. The reason for these *Gods* and *Goddesses* being so adorned, are given in the explanation of the *Sculpture*, representing the motion of the *Planets*: The *Child* in *Saturns* Arms, and which he seems to devour, relates to the Story fathered on him by the *Poets*, that as soon as ever his *Cœlestial Spouse* was brought to Bed, he did *eat* the *Children*, to prevent their dethroning him of his *Kingdom*.

The GLOBE and SPHERE of the Earth and Heavens, *Part* 4. *Chap.* 1. *fol.* 81. Represented by the Personal *Figures* of those two great *Geographers*, *Ptolomy* and *Copernicus*, the one with a pair of *Compasses*, taking seemingly the distances of some places, delineated on the *Globe* of the *Earth*; and the other holding a *Sea-Chart*, having a pair of *Compasses*, and the *Sphere* of the *Heavens* before him: The *Figure* seeming as it were to take an Observation, represents the Learned *Tycho*; on the *Table* are *Charts*, &c.

FOUNTAINS and RIVERS, *Part* 4. *Chap.* 4. *fol.* 88. Represented by the *Figure* of *Thame*, being an *Old Man* lying in the *Reeds* or *Osiers*, having an *Oar* in his Right Hand, and leaning his Left Arm on a *VVater-Pot*; as also by the *Figure Isis*, being a *VVoman* sitting on a *Rock*, having also a *VVater-Pot*. *Thame* and *Isis* are storied to be *Man* and *VVife*, and stand as *Godfather* and *Godmother* to that most ample River, vulgarly, *Thames*, it bearing the name of both, as *Thamesis*; as also by the *Figure* of a *Nymph* of the *Rivers* and *Fountains*, named *Arethusa*, holding a *VVater-Pot* and *Flowers*; and by the *Figure* of a *Young Man* named *Alpheus*, having a *VVater-Pot* and *Cornucopia* of *Flowers*, being the Patron of *Fountains*. The *Figures* are thus coupled, to shew that the Friendly Communication between *Rivers* and *Fountains*, resemble that between *Man* and *VVoman*: The *Figure* in the *Sky*, and seeming to press the *Clouds*, is the emblem of *Rain*.

The SEA, *Part* 4. *Chap.* 5. *fol.* 90. Represented by *Neptune*, God of the *Sea*, drawn in his *Charriot* by *Sea-Horses*, having his *Trident* in his Hand, being his *watry Scepter*, the *Hooks* at the ends of it, are to lay hold on his *subject Fishes*, who fail in their Allegiance: Behind him are the two *Figures*, holding and seeming to *sound* through their *Sea-Shels*, are representations of *Tritons*, *Creatures* formed by the *Poets* to serve his floating *Divinity* in the nature of *Trumpeters*. In prospect the *Sea* with *Ships*, &c.

The FIRE, *Part* 4. *Chap.* 7. *fol.* 99. Represented by *Vulcans Cave*, in which the *Cyclops* (the *Journeymen Blacksmiths* of *Vulcan*) are at *work*, in making *Thunderbolts* for *Jupiter*, who is placed above in the *Clouds*,

Clouds, attended as usually with his *Eagle*, as inspecting the well-making of his *Weapons*; and behind the *Anvil* stands a *Forge* of *Fire*, with a *Figure* seeming to blow it, which causes that *Smoak* that arises from the *Funnel* placed by *Jupiter*; below the *Cyclops* Feet lie *Breast-plates*, *Helmets*, &c. in some measure emblems of *Fire*, as owning their form and make, to his *Power*.

EARTHQUAKES and SUBTERRANEAN FIRES, *Part* 4 *Chap.* 8. *fol.* 103. Represented by the *Figures* of the four *windy Gods*, *Boreas*, *Eolus*, *Auster* and *Zephirus*, each with utmost strength blowing into a *Cavity* of the *Earth*, and heaving up of the *Rocks*, which in several places seem to break forth, and thereby throw down *Trees* and *Buildings*: At a distance the *figures* of *Men*, *Women* and *Children* affrighted, and running to avoid being buried in Graves of Nature, making the *Mountain*, whose top breaths flames of *Fire*, represent *Mount Etna*; these Convulsions of Nature are thus properly emblematis'd, it being the general Opinion that they are caus'd by *Winds*, being incloséd in some cavities of the *Earth*, who are forced to break the surface to find a passage to their proper center.

The AIR, *Part.* 4. *Chap.* 11. *fol.* 108. Represented by *Juno* the Monarches of this *Element*, with all her *Poetical Equipage* about her, and attended by her four *Handmaids*, *Iris*, *Imber*, *Cometa* and *Rugida*, who all have their *Aerial Imployments* under her; as 1*st*. *Iris* takes care of putting out and taking in the *Rainbow*. 2*dly*. *Imber* disposeth the *Rain*. 3*thly*. *Cometa* placeth the *Comets*. And 4*thly*. *Rugida* destributeth the *Dew*; all which employments are expreśt by the emblems that each of them bear.

METALS, *Part* 5. *Chap.* 1. *fol.* 113. Represented by the 7. *Deities*, who according to the *Poets*, patronise the 7. *Metals*; and they are placed in the *Clouds*: That in the midst is *Apollo*, or the *Sun*, holding in his right Hand a *wedge* of *Gold*, being the *Metal* he is said to produce; on his right Hand sits *Luna*, having a *wedge* of *Silver* in her Hand, being the *Metal* that owes its being to her proper bounty; that on the left is *Mercury*, arm'd and crown'd; he is said to produce *Quicksilver* by his celeritous Divinity: The four others that appear behind, are likewise said to produce the four other *Metals*; as *Mars*, *Iron*; *Jupiter*, *Venus* and *Saturn*, *Brass*, *Lead* and *Copper*: In the lower part on the ground, are Directors and Diggers of *Metals*.

The LOADSTONE, *Part* 5. *Chap.* 10. *fol.* 135. Its Virtues and Properties are demonstrated by the three *Figures* representing three *Philosophers*, one of whom holds a *Knife*, with a *Needle* on the *edge*; another having the *Compass* before him, and the other holding a *Loadstone* at a distance: The *Figures* of two other *Philosophers* seemingly discoursing of the *magnetick power* of this wonderful Stone.

The WINDS, *Part* 6. *Chap.* 2. *fol.* 136. In the *Sculpture*, *Apollo* sitting in the *Clouds*, and pointing to the *God* of the *Winds*, *Eolus*, who sits in the *Clouds* below him, adorned as before, commanding the four *Winds* expreśt by the four *Figures* of *Boreas*, *Zephirus*, *Eolus* and *Auster*, with their proper emblems as before, to discharge their Office; their execution of his Commands are visible in the effects of the *Wind* upon the seemingly tost and overwhelm'd *Ships* in the *Sea* below.

The NYMPHS of the *Air*, emblems of *Clouds*, *Mist*, *Snow*, *Hail*, *Rain*, *Dew*, &c. *Part* 6. *Chap.* 3, 4, 5, 6. *fol.* 139. 1*st*. Represented by two *Nymphs* of the *Air* in their proper array, young, beautiful and winged, stretching out their *Arms*, as gathering together and dilating the *Mists*. 2*ly*. The Nymph *Nix*, scattering of *Snow* through a Sieve. 3*dly*. The Nymph *Imber*, pressing the *Clouds* to provide *Rain*. 4*thly*. The *Figure* of a *Man* scattering small *Hail* out of a *Water-Pot*; and underneath three *Figures*, the middlemost representing *Dew*, the 2*d*. *Snow*, and the 3*d*. small *Hail*. In prospect a *Landskip* covered with a cast of each of their Offices to which they are assigned by the *Poets*, and therefore may properly be used in *Sculpture*, it being an attendant of Painting, which is *Poema silens*.

STORMS and THUNDER, *Part* 6. *Chap.* 7. *fol.* 147. *Thunder* is represented by *Jupiter*, preparing to cast his noisie *Bolts*: and the Storms by *Eolus*, the *God* of the *Winds*, commanding the four Heads who breath out *Storms* in their *Stations*, as *Boreas* in the *North*, *Zephirus* in the *West*, *Auster* in the *South*, and *Eolus* in the *East*: Below is the true emblem of a Storm, being *Ships* tost in a rugged *Mountanous Sea*; the *Fires* seeming to blaze on the *Main Yards* of the *Ship* are two *Sea Wills* in the *Wisp*, and made by the *Poets*, tho' not *Gods*, yet *Godlings* of the *Sea*, and Protectors of *Seafaring-Men*, and by them named *Castor* and *Pollux*, the names of two Brothers, reported to have been drown'd.

The RAINBOW, *Part* 6. *Chap.* 9. *fol.* 151. A *Rainbow* proper, surmounted by *Iris* the *Goddess* thereof, the Rays of the *Sun* darting on it; by which, as we conjecture, it receives those beautiful and various Colours: The *Figures* below, represent *Philosophers* as consulting concerning its *Nature*; and about that *Ignis-Fatuus* which appears in the *Fields* of the *Landskips*; the representation of a *Nymph* or beautiful *Virgin*, placed on the *Rainbow*, took its rise from *fancy*, but since hath been attested for reality by a Captain of a Ship, who solemnly asserts his having seen it so.

GARDNING, *Part* 7. *Chap.* 1. *fol.* 156. In the *Sculpture*, the 1*st*. *Figure* is the Goddess *Rea*, Commandress of the *Earth*, seated thereon, as her proper *Throne*, having a *Castle* on her *Head*, and a *Lion* by her Side, emblems of her Strength and Power; next her is *Hebe*, one of *Jupiters* Cup-bearers, pouring out *Wine* on the *Earth*, as the Tyth due to her producing it; the next *Voluntina*, who assists the *Flower* in *budding*; then *Flora*, embracing the *Plantine-Tree*, being consecrated to her, and holding in her Hand a *Flower*, being Goddess thereof; behind *Rea* is *Virtumnus*, holding one *Fruit*, and eating another; on the left side of the *Tree* is *Nodinus*, holding the *Leaves* as it *buds* into *Branches*: Next is *Proserpina*, who hath the care of the *Bud* till it is out of the *Earth*; behind *Nodinus* is *Patelena*, holding a *Leaf* in its full perfection: The reason for thus representing Gardning, arises from the authority of the *Poets*, who have made all these *Gods* and *Godesses* concerned in the preservation of those *Vegteables* that adorn it, tho' I suppose they only meant the *Garden* of the *Muses*, in which none but they and their Successors were to be allowed the liberty of walking: In the upper part of the *Sculpture*, are the representations of *Jupiter*, *Juno*, *Saturn*, *Feronia* and *Luna*, in their proper emblems, relating to their several *Empires*, as before discourśd of, and intimates the necessity of the good will of *Heaven*, and temperate seasonable *Weather* to bring the *Fruits* of the *Earth* to perfection.

NATURE of ANIMALS, *Part* 8. *Chap.* 1. *fol.* 175. For *Animals* begot, they are represented by a *Woman* suckling her *Child*, having a *Cradle* standing by her; their *Thirst* represented by a *Cow* a drinking; their *Hunger* by a *Deer* grazing, their *Action* by two little *Dogs* a playing; their *Sleep* by a *Cat* a sleeping; their *Wakefulness* by a *Cock* sitting on his Pearch, and seeming a Crowing; their *Sickness* by a *Farrier* bleeding of a *Horse*, and their *Death* by a *Horse* lying dead.

IMAGINATION, *Part* 9. *Chap.* 6. *fol.* 214. Represented by a *Woman* in a sendentary posture, having on her *Head* a pair of *Wings*, and a *Coronet* composed of small *Figures*, which *Figures* denote the productive faculty of *Imagination*, and the *Wings* its swiftness: The *Child* standing by the *Figure* of *Imagination*, partly *black* partly *white*, denotes the strength of this *Passion*, being able (as by this Example appears) to perform those things, which neither *Human Wisdom*, nor the common way of *Natures working* could effect: The other *Figure* having *Eyes* vailed, and *Wings* on her *Back*, represents what *Women* call *longing*, 'tis swift as *Wings* to *Desire*, and blinded to *Reason*.

MEMORY, *Part* 9. *Chap.* 7. *fol.* 216. Represented by a *Woman*, having a Steel Cap on her Head, set with Jewels, denoting the Strength and Riches of this *Faculty*; she is putting her *Finger* to her *Ear*, as the proper *Organ* by which this Good is received; and in her *Hand* she holds the Picture of a *Man*, whom she knows, tho' absent, by the means of *Memory*; below are the representation of *Children* conning their *Lessons*, *and* of a *School-Mistress*, who seems awing them with a *Rod*; The Statue on *Horseback* is the representation of King *Charles* II. as the propereśt object to exercise this Noble Faculty of *Memory* upon.

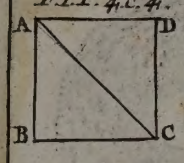
The *Author* having asserted in his *Discourse* of the want of *Sense* and *Knowledge* in *Brute Animals*, that they are nothing more than *Machins*, moving in their several *Stations* by Natures *Clockwork*: His ingenious position is *illustrated* by the *Sculpture* that fronts the said *Tract*. Firśt on the foreground is the *Figure* of a *Woman*, being the representation of *Dædalus* his *Wooden Venus*, which imitated the *Action* of a *Woman*; next in the midst the *Figure* of a *Man*, being that *Iron Statue*, which presented a Petition to the *Emperor* of *Morocco*, as taken notice of in the latter end of that *Authors Preface* to the *Reader*. On the Right Side of this *Figure*, is that of a *Man* with a *Drum*, which artificially beats on it, and at the same time performs several *motions* with his *Head* and *Eyes*; which *Clockwork* was shewn in *London* not long since. Between these aforesaid three *Figures*, is a *Dial* and a *Dog* sitting, which is another piece of *Clockwork*. At a distance on the second ground, is supposed the *Army* of *Maximilian* the Emperour, over whose Head is an *Eagle*, being the representation of the *Norimberg Eagle*, framed by *Athanasius Kirchir*, which flew over his Head, and accompanied him in his return to the *City*. Then on a *Hill*, a *Statue* of a *Man*, which saluted the *Sun* at his rising, with a Hymn *Musically* composed: And to conclude, a *Pidgeon* framed by *Architus* the *Tarentin*, which flew in the *Air* like a living *Bird*; all which the *Author* hath taken notice of, to which I refer the *Reader*.

THE

Figures or Schemes in the Institution of Philosophy. Plate 1.

Note F. Signifies Figures P. Part C. Chapter.

F. 1. P. 4. C. 4.



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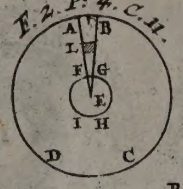

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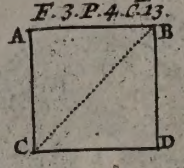

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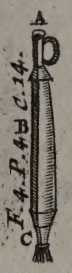

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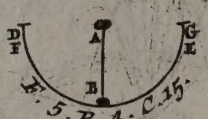

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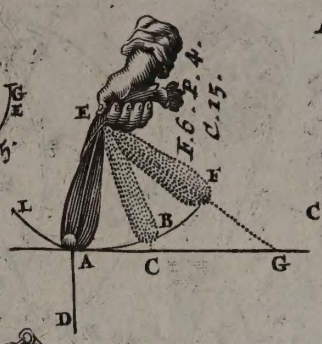

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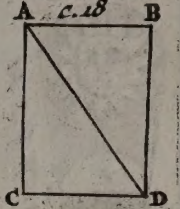

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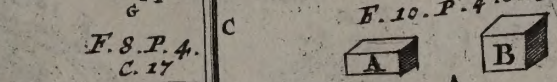

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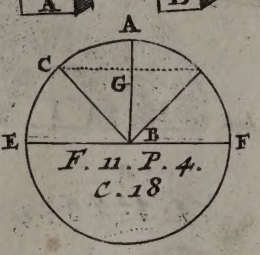

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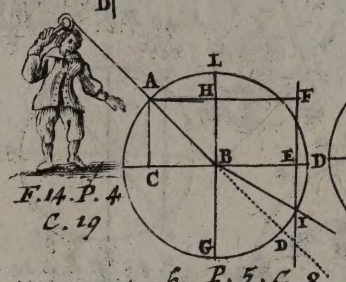

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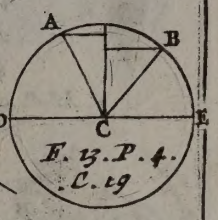

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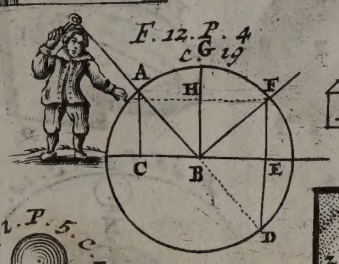

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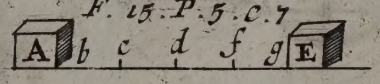

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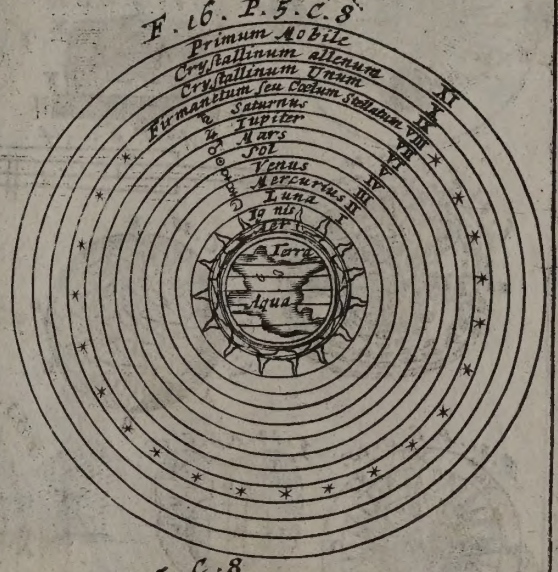

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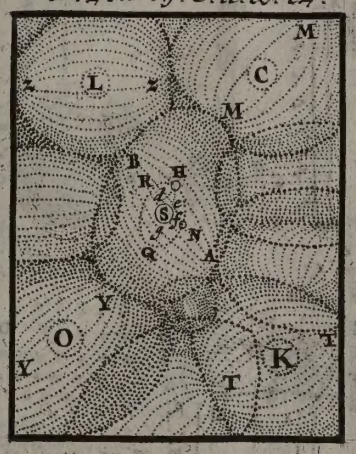

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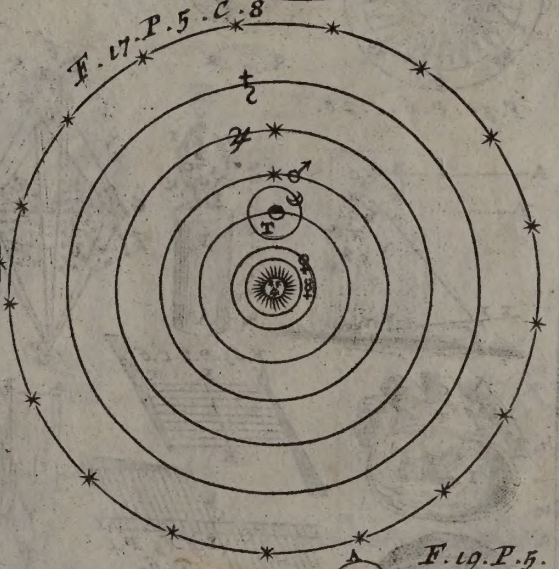

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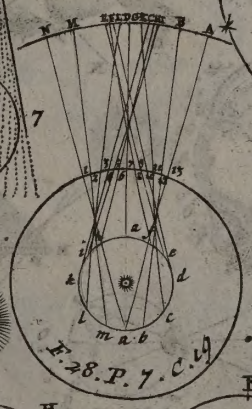
F. 27. P. 5. C. 17

F. 28. P. 7. C. 19



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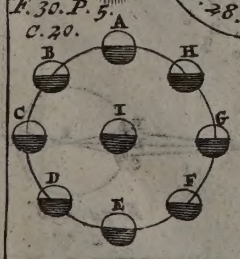

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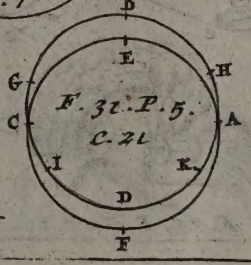

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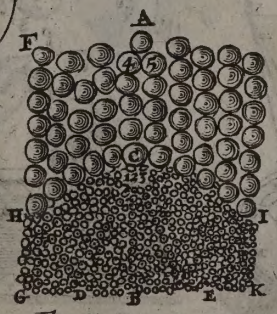

Figures or Schemes in the Institutions of Philosophy. Plate 24

F. 34. P. 5. C. 22

F. 35. P. 6. C. 2.

F. 36. P. 6. C. 2.

F. 34. P. 5. C. 21

F. 33. P. 5. C. 21

F. 40. P. 6. C. 6

F. 37. P. 6 C. 2

F. 38. P. 6. C. 2

F. 39. P. 6. C. 5.

F. 42. P. 6. C. 10.

F. 43. P. 6. C. 10

F. 44. P. 6. C. 10

F. 45. P. 6. C. 10

F. 48. P. 6. C. 14.

F. 42. P. 6. C. 10.

F. 50. P. 6. C. 16.

F. 49. P. 6. C. 14.

F. 47. P. 6. C. 14.

F. 46. P. 6. C. 12.

F. 54. P. 6. C. 18.

F. 51. P. 6. C. 16.

F. 52. P. 6. C. 16.

F. 53. P. 6. C. 17.

F. 58. P. 6. C. 20.

F. 55. P. 6. C. 19.

F. 56. P. 6. C. 20.

F. 57. P. 6. C. 20.

F. 64. P. 8. C. 6.

F. 73. P. 8. C. 19.

F. 60. P. 7. C. 20.

F. 59. P. 6. C. 22.

F. 61. P. 7. C. 21.

F. 63. P. 8. C. 6

F. 62. P. 8. C. 6.

F. 65. P. 8. C. 6.

F. 66. P. 8. C. 6.

F. 68. P. 8. C. 6.

F. 69. P. 8. C. 17.

F. 67. P. 8. C. 8.

F. 71. P. 8. C. 23

F. 72. P. 8. C. 19.

F. 70. P. 8. C. 17.

F. 76. P. 8. C. 22.

F. 75. P. 8. C. 22.

F. 74. P. 8. C. 19.

Figures in the History of Nature

Plate 3.

F. 1. P. 1. C. 2.

F. 2. P. 1. C. 4.

F. 3. P. 1. C. 2

F. 4. P. 1. C. 4.

F. 5. P. 1. C. 6.

F. 6. P. 1. C. 6.

F. 7. P. 1. C. 9.

F. 8. P. 2. C. 7.

F. 9. P. 2. C. 7

F. 10. P. 2. C. 7.

F. 11. P. 2. C. 8.

F. 12. P. 2. C. 8.

F. 13. P. 2. C. 9.

F. 14. P. 3. C. 8.

F. 15. P. 3. C. 9.

F. 16. P. 3. C. 10.

F. 17 P. 3. C. 12

F. 18. P. 4. C. 2.

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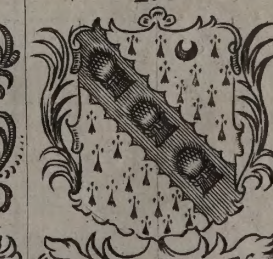

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Sudore et Sanguine

This Plate is humbly Dedicated by Richard Blome.

The First Part:
OF THE
INSTITUTION
OF
PHILOSOPHY.
CONCERNING
LOGICK.

INTRODUCTION.

CHAP. I.

Of the Nature and Constitution of LOGICK.

I. *What we are to understand by the word LOGICK.*

FOrasmuch as the Mind of Man is obnoxious to many Errors, as well in the searching out of *Truth*, as in the pursuit of that which is *Good*, in both which it is frequently mistaken; two *Arts* have been found necessary, whereof the former might direct the *Will* in the choice of the *True Good*, and the latter assist the *Understanding* in the discovery of *Truth*. The first of these, called ETHICKS, is an help to human Infirmity, directing the *Mind* of Man in the prosecution of *Good*, and shewing it what it ought to embrace, and what to avoid; the other called LOGICK, is the *Rule* of Man's *Thoughts*, which he is to observe in the framing of them, and by means whereof he may communicate his *Perceptions* and *Judgments* to others.

II. *The Definition of* Logick.

For LOGICK is nothing else, but the *Art of right Thinking*, or of *using our Reason aright*; where by the word *Thinking* we do not only understand simple Idea's or Notions, but also *Judgments* and *Discourses*: For he who *Reasoneth* or *Judgeth*, thinks as well as he, who only attends to simple Notions. So that *Logick* extends it self to all kind of *Thoughts*, and gives Rules to all the *Actions* of the *Mind*; because *Discoursing*, *Judging* and *Conceiving*, are but so many different Modes of *Thinking*.

III. *Why* Logick *is called the* Art of right Thinking.

It is to be observed, that LOGICK is not simply said to be the *Art of Thinking*, because Thinking is Natural to us, and the spontaneous products of our *Mind*; but the Art of Thinking *aright*. For since *Thinking* may be performed well or ill, there is need of an *Art* that may rightly direct the Actions of the *Mind*, and prescribe Rules for the discerning of *Truth* from *Falshood*. For as the Art of *Husbandry* teaches the convenient ordering and disposing of those *Plants*, which otherwise grow of themselves and at random: So *Logick* furnisheth us with *Rules* to define Things, to sort them under their General Heads, and furnish them with their Adjuncts.

IV. *How* Logick *assists the* Mind.

Wherefore LOGICK may be said to be the *Art of Knowing* each Knowable that can be the Object of Human Understanding: Not that it informs the *Mind* of the Things themselves, for that is the Duty of *Natural Philosophy*; but because it discovers the Ways of *right knowing* in general, and delivers those *Rules* by which the *Mind* of Man may be directed, whilst it endeavours to know any thing, so as not to wander from the Path of right *Reason*.

V. *Four things* roquired to *the use of* right Reason.

Now, that a Man may use *right Reason*, and be able to frame his *Thoughts* aright, and interpret them to others; it is necessary for him to *Perceive aright*, *Judge aright*, *Reason aright*, and *Order aright*.

VI. *First, to Perceive.*

We are said to *perceive* a thing, when we clearly and distinctly conceive the Object offer'd to us: As when we represent to our Thoughts *God*, an *Angel*, a *Circle*, a *Triangle*, and stop there, without forming any Judgment concerning them. And the Form, by the immediate perception whereof we are conscious of our knowing any Object, is called an *Idea*.

VII. *What we are to understand by the word* Idea, *or* Species.

For by the word *Idea* we are not to understand any Representations impress upon our Senses; but those Images of Things, which the *Mind* frames by Thinking. For the easier apprehension whereof we are to observe, that in the *Idea* or Notion of a

Thing two things are to be conſider'd: *Firſt*, That it is a *Modus* inherent in the *Mind*, from whence it proceeds: The *other*, That it ſhews or repreſents ſomething. The former of thoſe proceeds from the *Mind*, as its effective Principle; the latter from the *Object*, or thing apprehended, as from its Exemplary cauſe. So that when we frame the *Species* of any thing by Thinking, that firſt view of our *Mind*, by which it repreſents and conceives the Thing as preſent, is called *Perception*, or in other words, *The firſt operation of the Mind*, or *Simple Apprehenſion*. So that this *Perception* is ſaid to be Simple, not with reference to the *Object*, which often is complex (as when the *Sun* is conſidered as a *Light* or *Lucid Body*;) but with reſpect to the *Modus*, under which the Thing is conceived.

VIII. *The Second, to* Judge. We are ſaid to *Judge*, when we affirm or deny any thing of the ſaid known Objects; or when we by the Action of our Mind joyning two *Idea's*, aſſert the one to be the other; or deny the one of the other. As when conſidering the *Idea* of the *Sun* and that of *Fire*, we affirm the *Sun* to be Fire, or deny the *Sun* to be Fire.

This way of *Thinking* is different from the foregoing, foraſmuch as this is not the Simple apprehenſion of a thing; but a Compound, *viz.* an *Affirmation* or *Negation*, and is commonly called a *Propoſition*, becauſe the *Mind* thereby propounds its Sentiment of Things. It is alſo called *Judgment*; foraſmuch as by this Mode of *Perceiving*, we do not barely apprehend a thing, but alſo judge or determine what it is, or is not.

IX. *The Third, to* Diſcourſe. To *Reaſon* or *Diſcourſe* is that Action of our Mind, which frames a *Judgment* of many others, or which from two *Propoſitions*, or from one, infers another: As for Example, After it hath judged that a *Body* is a Subſtance extended in Length, Breadth and Depth, and that *Heaven* is a *Body*; infers the *Heaven* to conſiſt of three Dimenſions.

So likewiſe obſerving that the *Idea* of a *Man* agrees with that of an *Animal*, but doth not agree with the *Idea* of a *Plant*, concludes, That therefore neither can the Idea of a *Man*, ſuit with that of a *Plant*. Wherefore finding that *Man is an Animal*, and that an *Animal is not a Plant*, it infers this Third *Propoſition*, that *therefore Man is not a Plant*. This way of Thinking is call'd *Diſcourſe*, becauſe by running from one *Propoſition* to another, it comes to a Third.

X. *The Fourth, to* Order. To *Order* is an Action of the *Mind*, whereby many things found in the ſame *Subject*, are diſpoſed in a fit and congruous manner: As when the *Mind*, after it has fram'd ſeveral *Idea's*, *Judgments* and *Argumentations*, digeſts them in the moſt convenient and fit manner, for the ready and diſtinct conceiving of them.

XI. *Of what uſe the obſerving of theſe Rules is.* So that he that would proceed according to *Order*, muſt begin with thoſe things that are more known, paſſing on to ſuch as are leſs; and in the ſame manner proceed all along from one thing to another, ſo as that which goes before may always afford light to what follows.

If any one ſaith, That all theſe things may be done by the conduct of *Nature* only, ſince Experience ſhews, that ſuch Perſons ſometimes perform them more exactly, who are wholly ignorant of the *Rules* of *Logick*, than they who have ſtudied them: We freely grant as much, nor do we pretend this Art to conſiſt, in preſcribing the *Modus* how thoſe *Operations* are to be done, ſince *Nature* alone is ſufficient to make us *Perceive*, *Judge*, *Diſcourſe* and *Methodize*, without any foreign aſſiſtance. Yet is not *Logick* therefore to be judged uſeleſs, becauſe it helps us to examine our Actions, and obſerve thoſe Things which we do by Natural inſtinct.

XII. *The Threefold uſe of* Logick. As, *Firſt*, that we may be aſſur'd that we uſe our *Reaſon* aright. *Secondly*, That we may with more eaſe diſcover the Miſtakes, or ſupply the Defects, that may intervene in our *Mental Operations*. For it oft happens, that by the ſole Light of Nature we are aware of ſome *Falſhood*, and yet are ignorant where that *Falſhood* lurks. As we find that Men ignorant of the Art of *Limning*, are often offended with a Fault they ſee in a Picture; tho' they cannot make out what properly the Defect is wherewith they are diſpleaſed. *Thirdly*, That the Nature of our *Mind* may be the more diſtinctly known by us, whilſt we obſerve and give good heed to thoſe Actions that are proper to it, and which vaſtly raiſe it above all Bodily things. Wherefore ſeeing that the *Mind* ſuffers it ſelf ſometimes to be impos'd upon by falſe Repreſentations, it has been found neceſſary to preſcribe ſome *Rules* by which it might be aſſiſted in its Operations, in order to a more certain reaching of *Truth*. And accordingly the whole aim of *Logick* is to inform us, how we ought to make uſe of our *Reaſon*, and what Evidence we ought to have, before we give our Aſſent or Diſſent to things, which by *Idea's* are preſented to our *Underſtanding*.

XIII. *Logick divided into Four Parts.* Whence follows, that *LOGICK* is to be divided into Four Parts, according to the divers Reflections we have of theſe Four Operations of our Mind. The Firſt, concerning *Idea's*, or the ſimple *Perception* of Things: The Second, of *Judgment*, or of *Propoſitions*, wherein is *Truth* or *Falſhood*: The Third, of *Diſcourſe* or *Syllogiſm*: The Fourth, of *Method*, or the *Orderly digeſting* of our *Thoughts*, by which, as by ſo many Steps, we arrive to the *Modus* or Way of Knowing. Foraſmuch as by the *firſt* we are led from *Inconſiderateneſs* to *Attention*; by the *ſecond* delivered from *Doubts* and *Errors*; by the *third* we are accuſtomed to *Reaſoning*; and by the *laſt*, we infallibly prove ſome *Truth*, or demonſtratively perſuade the ſame to others.

CHAP. II.

Of the true Uſe of LOGICK, ſhewing that Logick *is uſeful and neceſſary to the Conduct of a Rational Life.*

I. *The Opinion of the Ancients, concerning* Logick. LOGICK was always in ſo great eſteem amongſt the Ancients, that ſome of them admir'd it as a thing inſpir'd from Heaven, and look'd upon them as rais'd above the Condition of Men, who underſtood the *Rules* of it, and were dextrous in the practice of them. Wherefore *Cicero* tells us, that the *Contemplation and Knowledge of Nature is, as it were, by a Wall or Rampart ſecured and defended by the way of Reaſoning, by the Judgment of what is True or Falſe; and by a kind of Art of knowing what is agreeable and comporting with every thing, and what is contrary to them.* And for this Reaſon the *Philoſophers* of Old

Old have beſtowed ſeveral Names upon it, and meaſuring the dignity of it by its Neceſſity; have called it, the *Medicine of the Soul*, the *Organ* or Inſtrument *of Sciences*, and *the Eye of the Mind.*

II. *The* Logick *taught in the Schools hath its uſe.*

True it is, that *LOGICK* ſeems to have declined from its primitive Majeſty, ſince it now chiefly conſiders *Forms*, and is in a manner wholly taken up with the Reſolving of unprofitable *Queſtions:* Yet neither is it wholly to be undervalued upon that account, ſince thoſe *Queſtions* exerciſe the Wit of Men, and are not a little conducive to the examining of the Difficulties we meet with in other Sciences. As *Geometricians*, by exerciſing themſelves in the crabbed Queſtions of *Algebra*, which are altogether Abſtracted, and of no uſe for the Conduct of Life, are nevertheleſs thereby diſpoſed for the underſtanding of other difficult *Problems*, that are of great uſe in the Life of Man. In a word, which way ſoever we conſider *Logick*, we ſhall find it to be of uſe, and in that regard not inferiour to other *Arts* or *Sciences.*

III. *As* Phyſick *cures the Body, ſo* Logick *does the Mind.*

This will be evident, if we conſider *Man* in himſelf, and the *Diſeaſes* he is ſubject to. For a Man conſiſts of *Body* and *Soul*, which both of them have their *Infirmities* and *defects.* So that as *Phyſick* takes care of the *Body*, by removing *Sickneſſes* that afflict it; ſo there is need of *Science*, that may aſſiſt the *Mind*, by diſpelling of its *Darkneſs.* Wherefore *Logick* takes care for the *Souls* health, and conſequently is as neceſſary to the *Intellectual Life*, as *Phyſick* is to the *Body:* Nay, and is by ſo much the more excellent and neceſſary, by how much the Nobleneſs of the *Soul* exceeds that of the *Body*, and by how much its *Diſeaſes* are more hidden and more difficult to be cured.

IV. *Why* Phyſicians *are more eſteemed than* Logicians.

Neither is there any great reaſon of Wonder, why *Phyſicians* are ſo much reſpected every where, and favour'd with Honour and Riches; whereas *Logicians* are commonly very deſpicable: For the reaſon of this is, becauſe the Diſeaſes of the *Body* do affect the *Soul*; whereas the Diſorders of the *Mind* do only afflict it ſelf, and communicate little or nothing of their Smart to the *Body*; whence it happens, that in a manner all Mankind chooſe to lead an *Animal Life*, and but very few do follow a *Spiritual* or *Mental Life.* To which may be added, that the greateſt part of Men are little concerned about the Vices of the *Soul*, and being only intent on the Care of their *Bodies*, think themſelves moſt happy as long as they are in *health*; and all this, becauſe they are drowned in the *fleſh*, and wholly addicted to *ſenſe.*

V. *That* Nature *alone is not ſufficient to direct the Operations of the Mind.*

It is Notorious, that we brought no *Science* into the World with us, but that the ſame is acquir'd by *Induſtry*, or received from *Maſters:* But ſeeing there are few that are able to Teach us, and that they who undertake it are frequently deceived themſelves; we muſt find out a *Method*, whereby we our ſelves may correct our Errors, and endeavour to mend our Faults.

VI. *The force of Human Reaſon.*

If you ſay, that our *Reaſon* is ſufficient for this, whoſe property it is to know the *Natures* of Things, and to diſcern *Truth* from *Falſhood.* I anſwer, That indeed *NATURAL LOGICK*, or the very force and ſtrength of *Reaſon*, which we have by *Nature*, doth not a little conduce to the attaining of *Truth:* For it conſults thoſe *Rules* Nature her ſelf has preſcribed, and being informed thereby, examins its Operations and Diſcourſes by them. For to ſpeak truth, we naturally follow almoſt all thoſe *Rules*, which after long ſtudy and great pains taking, *Logicians* have delivered to us; ſo that *Nature* it ſelf ſeems to have taught us the *Art of Reaſoning*; but yet we find, that ſhe is not ſufficient to furniſh us with all neceſſary Knowledge, except ſhe be aſſiſted by *Precepts*, and perfected by *Art.* Who can deny, but that the Faculty of *Painting* is born with *Man*; and yet *Art* is neceſſary for the right forming of *Images.* All Men are endued by *Nature*, with a power of Speaking and framing of *Words*, which yet will never be reduced to *Art* without Uſe and Exerciſe; ſince it is clear beyond doubt, that ſhould an *Infant* from his Birth be left alone, it would continue *Dumb* all its Life, unleſs it were taught to Form *Words* and give them their due Sound.

VII. *The Neceſſity of* Logick, *proved by* Galen.

Thus *Galen* proves the Neceſſity of *Logick* againſt *Eraſiſtratus* by this Argument; *Either every thing follows from every thing, or not:* If you aſſert the former, then it will follow, that *becauſe a Crow is black*, and *a Swan white*, Eraſiſtratus *is a Fool and mad*; if the latter, then you muſt grant there is need of *Art*, that may inform us what follows and what not. For we cannot make out that a *Conſequence* is right, or a *Demonſtration* good, without the aſſiſtance of *Logick.*

VIII. *Natural and Artificial Logick.*

LOGICK therefore is to be diſtinguiſh'd into *Natural* and *Artificial. Natural Logick* is that force of the *Mind*, by which it rangeth its *Thoughts* and reduceth them to order, or elſe Diſcourſeth ſpontaneouſly without obſerving any order. *Artificial Logick* is that which is acquired by Uſe and Practice, and at firſt took its riſe, and increaſe afterwards from various Obſervations taken from the Actions of the *Mind.*

IX. *The Uſe of Artificial Logick.*

Wherefore tho' we bring *Natural Reaſon* along with us into the World, yet is not that ſufficient to direct the Actions of our *Minds:* For we find that notwithſtanding the Uſe of *Reaſon* we fall into many Errors, and labour under the Prejudices of Infancy; and therefore muſt conclude, that *Artificial Logick* is not only uſeful, but neceſſary to cure the Diſeaſes of the *Soul*, and to direct and guide its Operations: Where, by the *Souls* Diſeaſes, I do not mean *Sins* and *Moral delinquencies*, the Cure whereof is endeavoured by *Divines* and *Moraliſts*; but the Weakneſs of our *Mind* in the Perceiving of Things; *viz.* all manner of *Errors*, *Confuſions* and *Obſcurities* of our Conceptions; Falſe and uncertain *Judgments*, and undue Conſequences in our *Reaſonings*, the diſcerning and removing whereof is the whole buſineſs of *Logick.*

X. *Doctrinal and Practical Logick.*

There is another common Diviſion of *LOGICK* into *Doctrinal* and *Practical. Doctrinal Logick* is that which delivers the ſeveral *Rules*, directing us in *Perceiving*, *Judging* and *Reaſoning. Practical*, is that which applies thoſe *Rules* to Uſe and Practice: For which reaſon the Ancients called the former *Abſtracted* or *Separate from Things*; but this latter, *Concrete* or *joyned to the Things* themſelves we are diſcourſing of.

The

The First Part.

Of the Clear and Distinct Perception of the Mind.

SEing it is evident from the foregoing Discourse, that there are Four Parts of *LOGICK*, correspondent to as many distinct *Operations* of the *Soul*, about every *knowable* Object: We will here begin with the First Part of it, which directs the simple Perceptions and Apprehensions of our *Mind*. And to perform this the more effectually, we will endeavour to take out of the way the several Hindrances of *Science*.

CHAP. I.

What the Hindrances of Science *are, and how to be removed.*

I. *The chief Causes of our Mistakes.*

THere are Two things by which we are easily led aside into the By-way of *Error* and *Falshood*, viz. *Prejudice*, which makes us take up any thing for *Truth*; before *sound Reason* hath convinced us of it; and *Slavishness*, by which we are so addicted to the Opinions of others, that we think it a Crime to differ from them.

II. *We are very subject to be seduc'd by the Prejudices of* Infancy.

Wherefore it is no wonder that we find so few Men truly Wise, and who know the Causes of Things aright, seeing they scarce consider any Thing well and duly throughout their whole Life, and do not so much give their assent to Right *Reason*, as to their *Prejudices* and the Testimony of their *Senses*. For the force of *Prejudices* is so prevalent with some, that they cannot admit any thing for *Truth*, which is not grounded on those false Opinions they have suck'd in from their *Cradles*. Wherefore it will be worth our while to shew, how vain the Things are we then know, and that we ought to distrust and suspect whatsoever proceeds from such weak *Causes*. For what did ever any *Infants* perceive, which they did not wholly refer to their *Bodies*, and which they did not desire or dread, according as they fancied them hurtful or grateful to the same? Thus we see they are pleased with the Light and Shining things, because *Refulgency* with its Beauty pleaseth their Eyes; whereas they dread a *Rod*, because with it they are chastis'd and put to pain. Wherefore *Children* judge of things, as they appear to their *Senses*; As that the *Earth* is far bigger than the *Sun*, and the rest of the Heavenly Bodies; because the *Earth* is nearer to them, the other being at a great distance from them. Thus likewise they think, that there is more Matter in *Lead* and other Metals, than there is in *Fire* or *Air*; because they find more Weight and Hardness in the one than the other. And again, because they perceive no more Brightness from the *fix'd Stars* than from the small Light of a *Candle*, they are apt to think that the *Stars* do not exceed the bigness of a *Candle*, and therefore fancy them as so many bright and shining *Studs* fix'd in the Firmament of *Heaven*; whereas there is no *Natural Philosopher* but knows, that the *fix'd Stars* are equal to the *Sun* both in Bigness and Brightness.

III. *The Prejudices of* Childhood *hinder us after we are come to the use of Reason.*

Now these Errors are not only to be found in *Infancy*, but in process of Time they get strength, and become so rooted into Mens *Minds*, that they accompany them the whole course of their Lives. Hence it is that we meet with some that have the Gravity of *Old Age*, but at the same time are subject to the Weakness of *Children*. Which Mistakes arise from hence, because they suppose that the Opinions they have taken in during their *Childhood* and *Youth*, are inborn *Notions*, and common to all Mankind. Whereas they ought to consider, that they have admitted many things for *Truth*, without any sufficient Examination, and that therefore they ought rather to think them to be *false* than *true*. But the case is the same with them, as with those that have Sore-Eyes, who delight in *Darkness* and are offended with the *Light*; for they hug their *Errors*, and are loath to part with them.

IV. *Some only give credit to the report of their Senses.*

Some of the *Philosophers* of Old were not free from this Weakness, who asserted the *Sun* not to be above two Foot over, because they had never seen it greater. And it was to no purpose to persuade them by *Astronomical Arguments*, that it was not only far greater than so, but many times bigger than the *Earth*; because their preconceived Opinion was so rooted in them, that they could no otherwise apprehend it. Thus likewise when they were *Children*, and thought of nothing but what was Bodily, they thought nothing could be Corporeal, but what must be Sensible also, from which Prejudice they concluded afterwards, that there could be no *Insensible parts*. If one argues against this, that such Parts must of necessity be admitted to avoid a *Vacuum* in Nature, and for the Explication of many *Natural Appearances*; they have nothing else to answer, but that they cannot see them, and that they are not certain of any thing, except it fall under their *Senses*. From the same Prejudice it is, that they conceive all *Immaterial things* after the manner of things Sensible, and apprehend the *Mind of Man*, not as a *Thinking Being*, void of all Matter, but like a *Wind* or *Fire* infus'd into the Grosser parts of the *Body*, to which tho' they attribute the Name of *Spirit*, yet conceive of it under a Bodily likeness. Wherefore also they greedily embrace that Maxim of *Aristotle*, That *there is nothing in the Understanding, which was not first in the Senses*.

V. *And therefore assert, that God cannot be known but by sensible things.*

If we go further and tell these Men, That *God* doth not fall under any of our *Senses*, and therefore cannot be conceiv'd of under any sensible Form; yet by reason of their Inveterate Custom of *false Judging*, they rather chuse to frame several Distinctions, than to forsake their beloved Maxim, tho' only supported by *Childish Prejudices*; saying, That *God* is made manifest unto us by his *Effects*, or by some *Signs*, as by his *Creatures* and *Words* that signifie his *Nature* unto us. Which Prejudices do really divert the *Mind* from the *knowledge* of *Things*, and hinder it from ever attaining the true way of *Philosophizing*. For how can we think ever to attain it, if we always Judge after the manner of *Children*, and only believe those Things to be true, which through the *Senses* are conveigh'd to us? How can we ever think to make a right use of our *Reason*, if we only take those things to be good which are of Profit to us? If we think the *Air*, *Cold* and *Heat* to be nothing, when they do not sensibly affect us? Or, if we judge the *World* to end where our Sight is bounded, and innumerable other Things, which the Love of Antiquity, or the Authority of some Men have induced us to maintain.

Now

G. Freman Inv. *I. Kip Sculp.*

To the Right Honourable William Legge Baron of Dartmouth &c. Son of the Right Honourable George Lord Dartmouth, Master Generall of the Ordnance, Master of the Horse, Admirall of his Majestys fleet of Ships, and one of the Lords of his Majestys most Honourable Privy Councell &c.

This Plate is humbly Dedicated by Richard Blome

Gaudet Tentamine Virtus

To the Worship-
full John Emmerton
of the Middle
Temple London Esqs.

This Plate is humbly
Dedicated by Richard Blome

VI. *Education and Custom lead us into Error.*

Now all these *Prejudices* are much increased, by those Words which are in common use, and which the illiterate Multitude hath imposed; as having more reference to the Use of the *Body*, than to the Contemplation of Things. Moreover *Education*, *Custom*, and *Converse* with other Men, the *Authority* of those we reverence, the *Consent* of Mankind, and many other such like, hinder us from scanning of Things purely and sincerely, and lead us into many Errors. What hath once been prov'd to us, or believed by us, we scarcely ever reject, insomuch that the *Vices* and *Affections* of our Will, do communicate their contagion to our Mind and Understanding.

VII. *Hard and difficult things are apt to please us more than things easie and obvious.*

Sometimes it happens on the contrary, that those Things which are clear and perspicuous of themselves, are suspected by us; because Things obscure and liable to dispute do more affect us. Thus we are apt to contemn Experiments, as being too despicable, and our *Mind* desirous to take a higher flight, and hating to be confin'd to the narrow bounds of an *Experiment*, chooseth rather to please it self with some General Notions, which for the most part are of no use at all; and so prefer swelling *Words* of Vanity, which fill the Fancy, before things real and solid. Hence it is, that the High-flown Expressions of the *Platonists* and *Chymists* do allure so many. Besides, we are apt to suffer our selves to be deceived by the respect we have for *Antiquity* as well as by our affectation of *Novelty*, as if a thing were therefore true, because it is either New or Old, as if True things had not always been so, as if in this old Age of the *World* we might not expect the discovery of many Things heretofore unknown, or as if we might not look for a riper Judgment, and more knowledge from Old Men, that daily Experience many things, than from others.

VIII. *We must first examin our Opinions, before we lend an assent to them.*

We are therefore to examine our *Opinions* by the Standard of *Reason*, before we give our assent to them; and must judge those things to be True, not which the *Authority* of the Ancients, or the *Judgment* of most Men doth approve, but which are evidenc'd to be so by the strength of *Reason*. For the obtaining of which the following *Rules* will be helpful to us, if we seriously mind them, and judge of Things propos'd to us, according to their direction.

CHAP. II.

Some Rules for the Attainment of Truth.

The First Rule.

We are to admit of nothing that involves any thing of Doubtfulness.

I. *Doubts hinder us from the attaining of Truth.*

THe Light of *Nature* assures us, that *Doubting* is an obstacle to *Science*; and that we can never attain it, as long as the thing we apprehend is not clearly and distinctly represented to our *Mind*. Wherefore we shall do well to esteem all *Doubtful Matters*, as if they were false, and despise them as hurtful *Images*, that are apt to lead us into Error. For seeing that all Things that are built on any *Principle*, derive all their Certainty from the same; if that *Principle* be weak and tottering, the superstructure must partake of the same Conditions.

II. *Yet must not this be too scrupulously observ'd in matters of daily business.*

But tho' this *Rule* be of use for the clear knowing of Things, yet must we not extend the same to Human Prudence, or the use of Common Life. *For it often happens, that we are forced to embrace what is least suspected; and to esteem that as Good, which doth least hurt another.* Thus the Laws wink at the Toleration of *Whores*, to prevent the greater Evils of *Rapes* and *Adultery*. Thus in Human Actions we are forc'd to choose that which seems probable, and to leave that which is more true. But in the Search of *Truth*, whatsoever hath the least Doubt in it, is to be rejected, and is no more to be regarded than if it were a thing feigned at pleasure. *For whatsoever doth not conduce to the attaining of* Truth, *must be look'd upon as a straying from it.*

III. *The rejecting of Doubtful, is a help to the attainment of Science.*

Wherefore he that would *Philosophize* in good earnest, must rid himself of all the Prejudices of his Infancy, forasmuch as they have crept into our *Minds*, without any foregoing Examination of *Reason*; and therefore are to be consider'd by us, as *false*, rather than *doubtful*. Hence it is that our *Philosopher* saith, *I have now for some years consider'd how many false things from my first* Childhood, *I have taken up for True; and how uncertain and doubtful all those things are I have built upon them; and therefore that it were best once in my life to overthrow them all; and to begin again from the first Foundations, if ever I would desire to establish any thing in Sciences that might be firm and lasting.*

IV. *There is no danger in this Doubting of things.*

Neither need we to fear, lest by taking all things for *false*, we should be in danger of being deceived; because this Doubting is only indulg'd for to attain to greater certainty, and that we may the more evidently distinguish *Falshood* from *Truth*. For whatsoever includes the least Doubt, destroys *Science*, as hath been said, and leads to *Error* as well as *Falshood* it self. Is it not lawful for the *Philosophers* to suppose many Things, that by this means they may find out what is most certain and easiest to be known? Thus the *Astronomers* imagin an *Æquator*, a *Zodiack*, and other *Circles* in the Heavens, that by the help thereof they may the more accurately describe the *Sun*'s Course. *Geometricians* also make use of the like Suppositions, when with new *Points* they measure *Lines*, and to the *Figures* given add other Lines. Wherefore it will be of advantage to those who search after *Truth*, to reject all things that occur to them, and to give their assent to those things only, which they understand to be Certain and Evident.

V. *The way of Doubting approved by* Aristotle.

This way of Proceeding in the attainment of *Sciences* is not peculiar to *Descartes*, for *Aristotle* himself hath followed the same, as may be seen in the *First Chapter* of his *Third Book* of *Metaphysicks*, which bears this Title; *Of the Usefulness of Doubting, and what things we ought first to doubt of:* Where he speaks thus; *In order to our attaining the Science we desire, it is in the first place needful to take a view of those things we are first to doubt of; now such are all those things about which Men are divided in their Opinions, with other things besides. It being an Industry well worthy the pains of those who desire Knowledge, to Doubt aright.* Wherefore we need not think strange, that our Philosopher begins his Philosophy with *Dubitation*, and requires us to reject all those Opinions wherein we meet with the least cause of Doubting, that by this means we may at last find out a true and unshaken Principle.

The Second Rule of Truth.

We are not to rely too much on our Senses.

I. *The Senses are subject to mistake on several accounts: As,*

Forasmuch as our *Senses* are deceivable, and we are frequently imposed on by them, Common Reason will tell us, that we must not overmuch trust to them, but rather suspect whatsoever they offer to us; for it is a sign of *Rashness* and *Imprudence*, to trust them that have once deceived us. Now how apt our *Senses* are to deceive us, daily Experience teacheth. For it happens often, and for divers Reasons, that things appear otherwise to our *Senses* than they are indeed.

First, By reason of their *Distance*, as when the Object is so far from us, that all the *Reflex Rays* proceeding from it, cannot whole and entire reach us: As for Example, The *Sun*, and a *Square Tower* at a distance seem less, and otherwise figured than indeed they are.

Secondly, By reason of the *Medium*, as when the *Rays* are variously refracted in the same: Thus a *Stick* and other Bodies seen through the *Water*, appear Crooked.

Thirdly, By reason of the *Surface*, which as it appears to the *Senses*, doth not represent the Essential position of the Parts of the *Body* whose Surface it is: Thus the outside or superficies of a *Bean*, which falls under our Senses, represents a Figure very unlike that of a *Plant*; whereas the *Microscope* discovers to us, That it hath the same Essential disposition of Parts with the whole *Plant*, whose Seed it is. So likewise the *Spawn* of *Frogs* appears to our Eye, to be an Unorganical Mass; whereas the said *Magnifying Glasses* assure us, that they are distinguish'd into several Members. And the same may be proved by many more Instances. Neither is it to be doubted, but that there be many *Bodies*; the Essential Constitution of whose Parts were never yet discovered to us by any of our *Senses*, which if they were, we should judge otherwise of them, than the Vulgar do.

Fourthly, By reason of the *Impression* made upon our *Senses*, when the *Vibration* (caus'd by the Object) doth for some time continue; As when the *Sun* appears to our Eye after it is shut; or as when a *Torch* is with great swiftness turn'd round, whereby a *fiery Circle* is represented to the Eye, tho' the *Torch* be not in all the Points of the *Circle*.

Or when the Impression proceeds from something else besides the Objects; as in *Dreams* and strong *Imaginations*, *&c.* or when an Angel (by moving the Organ of *Sight*) doth represent himself to us.

II. *This Rule is not to be extended to the Actions of Life.*

Which deception doth not only frequently happen to our *External Senses*, but even our *Internal Sense* is not free from it. Thus we see, that those who are troubled with the *Vertigo*, think that all the Bodies about them turn round, and suppose the Air to be darkned: Thus likewise *Drunken* Men see all things double. Now when it is said, that we are not to trust the Testimony of our *Senses*, but are to look upon them as if they were false; we are to observe that this *Rule* must not be transferr'd by us to the *Actions* of *Life*. For it is contrary to Reason, not to trust our *Senses* in the conduct of our *Lives*: For by this means we shall make our selves guilty of the Folly of those *Scepticks*, who out of a foolish distrust of their *Senses* were ready to expose themselves to eminent danger of their *Lives*, but that their Friends hindred them. Tho' indeed, when the Question is about the bare knowledge of Things, then it is on the other hand every whit as Irrational, not to reject whatsoever is in the least doubtful, because things that are so, are as opposite to the attaining of *Science*, as those which are altogether false or unknown.

III. *Our Senses having once deceived us, are to be look'd upon as always liable to deceive us.*

And tho' our *Senses* sometimes may represent to us Things as they are, yet must not this hinder us from suspecting their Evidence: For having once deceiv'd us, they may always deceive us; or how can we rely upon them, which have once led us into Error? And therefore *Plato* in his *Phædrus* tells us, *That Men who are desirous of* Science, *know, that* Philosophy *having once undertaken the Care of their* Mind, *does by little and little inform it, and loose it of its Bands; representing to it, how deceiving the Judgment of the* Eyes, Ears, *and other Senses are, perswading it to leave them, as far as absolute Necessity does not oblige us to close with them, and to recall it self, and to recollect within it self, without giving credit to any thing besides it self.*

IV. *Our Senses are of no use, for the discerning of the Objects of Sciences.*

For our *Senses* are not given us by Nature for the searching out of *Truth*, or to contemplate the *Principles* of Things: Because if we take an exact view of the Objects of *Sciences*, we shall find that most of those things that occur to our Mind, are not represented by any Bodily Figure: As for Example, All the Objects of *Metaphysicks* and *Natural Divinity*, which admit nothing of any *Corporeal Form*. For we have in our Mind an *Idea* of *God* himself, whose Authority we believe, and whose Dominion over all we firmly are perswaded of. For how could we demonstrate so many things concerning *God*, if his *Idea* were not inherent in us? But do any of our *Senses* hand this Knowledge of God to us? What Phantasm manifests to us the General Notions of *Entity*, *Unity*, *Truth* and *Goodness*? What Species represents to us the Idea of *Angels*, or our own *Soul*, since there is nothing like them in the whole Universe of *Material Beings*, and with which they have not any thing in common, save only the Name of *Substance*? Wherefore it is very absurd to go about to derive all Knowledge and Idea's from the *Senses*. And if from these we pass to *Physical* or *Natural Beings*, we shall find that not only the Beginning of them are hid from our *Senses*; but that not so much as their Figures are represented to us, such as they are indeed, but very different from what our *Souls* upon enquiry find them to be. Do not we reach the Nature even of those thing that most strongly affect our Senses, as *Light*, *Heat* and *Cold*, far better by our *Understanding* than by *Sense*? And are not many times the most sensible Objects the least perceptible to our Intellectual Sight?

V. *To what end our Senses are given us.*

The *Senses* therefore are bestowed upon us by Nature to discover to us, who consist of *Soul* and *Body*, what things are good or hurtful for us; and we pervert the order of *Nature* when we put them to another use, and apply them to the knowledge of *Truth*, which are only design'd for the Preservation of the Compound. Wherefore also this may be reckon'd amongst the chief Causes of Error, wherewith we are possest from our Childhood, that we are apt to judge of things, not as they are in themselves, but only as they gratifie or offend the *Body*.

If

VI. *Objection, That the Senses inform us of many things.*

If any one object, That we attain to the knowledge of many Things by our *Senses*; that by our *Feeling* we perceive Bodies, as *Stones*, *Wood* and other things that come within the reach of our Hands; by our *Sight*, things at a distance, as the *Sun*, *Moon*, *Stars*, *Heaven*, *&c.* and that without them we could never have any knowledge of these Objects.

VII. *The Senses do only accidentally discover things to us.*

To this I answer, that I do not wholly reject the Service of the Senses; but only assert, that they are insufficient and inadequate for the knowledge of *Truth*. For tho' the *Senses* may inform us that *Bodies* exist; yet cannot they discover to us what those *Bodies* are, or what their Nature and Essence is; because this is not necessary for the Conservation of the Compound. And if ever they inform us what they are in themselves, this is only sometimes and by accident. For seeing that our *Senses* cannot perceive Corporeal things but through the intervening *Medium*, it is evident, that according as that is variously disposed, so their Judgment concerning them must vary accordingly. Thus we see that for this Reason the *Stars* appear to us of various Colours, sometimes more red, and sometimes paler, according as the *Air* that comes between our Sight and them is clearer or thicker. And therefore, as *Lucretius* saith, *Lib.* 4. *we have great reason to suspect, that the Inferences we fetch from our fallible* Senses, *must be false and deceivable.*

VIII. *How our Senses are said to be deceitful.*

But when we say, that our *Senses* are deceitful or subject to Mistake; we must not so understand this, as if there were an Error in the *Motion* it self, or in the affecting of the *Corporeal Organ*, because that is done by a kind of Natural Necessity; but because the *Mind* of Man, by reason of its intimate Union with the *Body*, doth from that Affection or Motion take occasion, to apprehend or judge of the thing amiss. And forasmuch as this precipitancy and inconsiderateness in Judging is commonly attributed to the *Senses*, and not to the *Mind*, the *Senses* are said to deceive us, because our *Judgments* follow those Perceptions that are attributed to our *Senses*.

The Third Rule of Truth.

Whatsoever we Perceive, we perceive with our Minds.

I. *Our Understanding is the searcher out of Truth.*

Forasmuch as *Divine Revelation*, or *Human Tradition*, have no admittance in *Philosophy*, and that according to the fore-going *Rule*, we are to suspect whatsoever comes from the *Senses*; it remains that the *Understanding* alone must be the sole searcher out of *Truth*, whose property it is to investigate the Natures of Things, and so judge of them according to the Attributes that are found in them.

II. *Not only common or general Natures, but particular also, are known by the Understanding.*

Neither is this only to be understood concerning *Essences*, or *Abstract Natures*, as the *Metaphysicians* call them; but of every particular Object that strikes our Senses. For it is the *Mind* alone which *sees*, *hears* and *feels* through the Organs. For *Gold*, by Example, *that is newly dug out of the Mine, doth at first sight look like* Earth, *and before Coagulation is more like* Sand, *than a Metal: But after it is once cast into the Furnace, it loseth the form of* Earth, *its parts run together and shine like a* Star; *and what before lookt so much like* Dirt, *now delights and pleaseth all Men.* So that my Senses at first perceived nothing of the Nature of *Gold*; for whatsoever my Sight or Touch before discovered of it, is quite changed, the substance of *Gold* still remaining.

III. *'Tis by the Mind alone we know Objects.*

Wherefore it is the *Mind* alone that knows the Nature of *Gold*, neither can we discern what it is, but by our Faculty of *Judgment*. We make no scruple to say, we see a *Man*, when we see one walking in the Market, tho' indeed we see nothing but his Cloaths, under which possibly a meer Machin might be conceal'd. It is plain therefore, that we do not make this Judgment by our outward Eyes, but by our *Faculty of Judging*, which is Internal.

IV. *It is by our Understanding alone we know that there are Pores in our Body.*

To explain this by another Example; Our *Skin* appears to us to be a continuous Body, without any Holes in it that our Eyes can perceive; but yet our *Mind*, by the Transpiring Sweat, concludes there must be *Pores* in it, by this way of Reasoning: *The Moisture that is sent forth through my* Skin, *is a Body; now a Body cannot pass from one place to another without passing through a* Medium; *wherefore it must follow that my* Skin *is like a* Sieve *or* Strainer; that is, of such a Texture, as to be full of little Holes, through which the Moisture may pass.

V. *Many things cannot be discovered to us by our Senses.*

This *Rule* is so certain, that whosoever denies it will never be able to attain any thing distinctly or by Reflex knowledge, which is necessary to Science. And though some relying upon *Aristotle*, suppose all our *Idea's* to arise from our Senses, and *that there is nothing in our* Understanding, *which was not first entertain'd in our* Senses; yet it is evident, that this Opinion, tho' common, is directly opposite to *Divinity* and true *Philosophy*. For first, there is nothing we perceive so distinctly as our *Thoughts*, neither is there any Proposition that shews it self to our *Mind* with fuller Evidence than this, *I think therefore I am*; and yet neither of these Idea's of *Cogitation*, or *Being*, were ever discover'd to us by any Sense: Not by our *Sight* or *Hearing*, as being without Colour or Sound; nor by any other of the Senses, because they have no Sensible qualities, or if they think they have, let them declare them. But if they cannot satisfie us herein, what remains but for them to own our Assertion, That the Notions of *Thinking* and *Being* do not depend on the Senses, but that our *Mind* forms them by its own proper virtue or efficacy; tho' we do not deny but the *Mind* may be sometime excited to the forming of them by outward things that affect our Senses.

VI. *GOD cannot be represented by any outward Appearance.*

Who can believe that the Idea of *GOD*, which is in us, doth proceed from our *Senses?* Or shall we think so, because some Ignorant persons conceive him under the form of a *Venerable Old Man*, as *Gassendus* tells us. But this is to confound and deprave *Idea's*, when we go about to imagin Spiritual things under a Bodily form: And he is in as great a Mistake, who would imagin Immaterial Substances as he is, who would hear *Colours* and see *Sounds*. It is apparently false therefore, that the Notions which we have of Spiritual things do proceed from the Senses; nay, what is more, it is certain that no Representations of Material things come to our *Mind*, save only occasionally; that is, forasmuch as the *Motions* made in our *Brains* (for nothing but *Motions* can affect our Senses) do give the *Soul* occasion of forming several Notions, which without them it would not do. Which *Notions* are also

wholly

wholly diſtinct from thoſe Motions and Repreſentations, which are in the *Brain* or *Senſes*. For they who are *Blind* and *Deaf*, tho' they receive no Species or Sounds from the *Objects*, yet are not without the Idea's of *Cogitations*, eſpecially when they reflect upon the things they are thinking of.

VII. *How the Idea of Immaterial things are ſaid to be inborn in us.*

Wherefore ſeeing we can perceive nothing by our *Senſe* or *Imagination* but what is Material, it follows that the Idea's of all other things that are not Material, are inborn with us; for by what other means could they be convey'd to our *Minds?* Yet when I aſſert that theſe *Notions* were put into the Mind in its firſt beginning, I would not be ſo underſtood, as if they did actually exiſt there, and were continually obvious to our *Thoughts*; but only that God hath vouchſafed a Faculty to our *Mind*, of exciting and producing ſuch Notions; as ſhall be more largely treated in the *Ninth Part*, concerning the *Mind of Man.*

The Fourth Rule of Truth.

That is True which we know clearly and diſtinctly.

I. Cogitation *is the Rule of Truth.*

Wherefore there can be no more certain Rule of *Truth* than our *Cogitation*, ſo that the ſame be but diſtinct and clear, and without the leaſt Doubtfulneſs; becauſe it is impoſſible for us to miſtake, as long as the *Judgments* we frame of any thing do correſpond to our *Perceptions*. It being an undoubted Axiom with us, *That our Knowing of a thing is a ſure Argument of its Eſſence.* Not as if becauſe we perceive the Eſſence of any thing, that from thence we ſhould preſently conclude that it exiſts: But becauſe it is impoſſible that any thing which is clearly known by us, ſhould not be ſuch as it is known by us; that is, the thing muſt exiſt, if its Exiſtence be perceived by us, or muſt be of this or the other Nature, if its Nature be repreſented to our Mind.

II. *From this Principle the Exiſtence of GOD is proved.*

From this Principle *Deſcartes* evidently demonſtrates the Exiſtence of GOD. *For if upon the account only* (ſaith he) *that I have ſuch an Idea in my Mind, it doth follow that whatſoever I perceive clearly and diſtinctly to belong to it, doth really do ſo; may I not from hence fetch an Argument for the* Exiſtence of God? *Yes ſurely: For the Idea of* GOD, *repreſents a Being abſolutely Perfect: Now it is every whit as repugnant to a Being abſolutely Perfect, to want any Perfection, as for Example,* Exiſtence, *as it is for a Triangle not to have three Angles equal to two right ones.*

III. *Provided it be clear and diſtinct.*

I ſaid in the Beginning, provided our *Cogitation* be clear and diſtinct; becauſe no Certainty can be expected from a thing, whoſe Knowledge involves the leaſt degree of Obſcurity or Confuſion. And therefore *Plato* in his *Timæus* tells us, That *when we diſcourſe of a firm, ſtable, and intelligible thing, our Reaſons alſo muſt be Stable, immutable, and inſuperable.* For ſeeing that clear and diſtinct *Knowledge* is ſomething which we our ſelves are not the Authors of, it muſt follow that GOD is the Author of the Connexion there is between clear and diſtinct *Knowledge*, and the aſſent which the *Will* infallibly yields to it. So that it is abſolutely impoſſible, that what I thus apprehend to be true, ſhould be falſe: As for Example, When I perceive *Two and Four to be Six*; *that in a Triangle there be three Angles equal to two Right ones*; and the like. It is impoſſible theſe ſhould be falſe; not becauſe they are ſo conceived by me, but becauſe except they were true, I could never have clearly or diſtinctly perceiv'd them.

IV. *It is impoſſible that what we clearly and diſtinctly perceive ſhould be falſe.*

For if any thing thus apprehended by me could be falſe, this would deſtroy all Human Knowledge; neither could any of us be ſure of any *Truth*, no not of the *Exiſtence* of *God*, nor of any of thoſe things which are related to us in Holy Writ: Since it might ſtill be objected to us, that thoſe very things may be falſe which we moſt clearly and diſtinctly perceive.

V. *Knowledge ariſing from the Senſes is Doubtful.*

But we cannot attain the ſame certainty of *Knowledge* in thoſe things which are only perceived by the Senſes, foraſmuch as they are liable to Miſtake: As when a Man, whoſe Eyes are deprav'd by a ſuffuſion of *Gall*, takes all things he ſees to be Yellow; and perceives the ſame as clearly, as thoſe who ſee the true Colour of every thing.

VI. *The certainty of our Perception depends on the* Understanding.

It remains therefore, that all the Certainty we have, is only of thoſe things which we apprehend with our *Underſtanding*. Neither doth it deſtroy this Rule, that ſome tell us they have ſometimes been deceived even in thoſe things which they thought to be moſt true, and which they were confident they had clearly perceived. For this happens to them, becauſe they derive the *clearneſs* of their Cogitation, not from their *Mind*, but from their *Senſes*, or from ſome preconceived Opinion: For we can never doubt of thoſe things which we clearly and diſtinctly know. As will be evident to thoſe who by frequent Meditation, and earneſt Study, have acquir'd a habit of Judging between a clear and dark Conception.

VII. *The foreſaid Rule is not to be extended to Believers.*

We are alſo to take Notice, that when we aſſert *that to be true which is evidently and diſtinctly known by us*; and therefore that we are not to give our Aſſent to things that are not ſo known by us, this is not to be underſtood of Matters of *Faith*; foraſmuch as they are not accompanied with any ſuch *Evidence*, neither have we any clear Notions of them, as we have of the Subjects of *Natural Sciences*. For there is a vaſt difference betwixt the *Myſteries of Faith* and *Natural things*, becauſe in theſe *Evidence*, but in the former *Authority* commands our Aſſent. That a Man may be a Believer, he muſt believe without Evidence; but to be a *Philoſopher*, he muſt have a clear and diſtinct Perception.

VIII. *How a man may be certain that he clearly knows a thing.*

If any Man demand, How he may be ſure of his knowing a thing clearly and diſtinctly? I anſwer; If he follow the Order preſcribed by *right Reaſon*; if he do not precipitate his *Judgment*, before he be enlighted with the *Truth* of Evident Perception. So that the Judgment of our *Underſtanding* muſt always go before, as it does when we never aſſert or deny any thing, except it be of Things we have clearly and diſtinctly perceived; that is, when our *Judgment* is exactly conform to our *Perception*. For it is not a ſufficient Argument for us to embrace any Opinion, becauſe there is Truth in it, except the ſame do appear to us; ſo as that our *Perception* may be the Rule and Line of *Truth* to us.

To the Right — Worshipfull S.r —
Thomas Mompesson — of Bathampton —
in Wilt-Shire — Knight —
This Plate is humbly — Dedicated by Rich: Blome —

A Tranſition, containing the ſubſtance of what hereafter follows, concerning the clear and diſtinct Perception of Things.

IX. *The Order or Series of things to be handled in the firſt Part of Logick.* Foraſmuch as it hath been made out, that the clear and diſtinct Perception of the *Mind*, is the one and only Rule for the attaining of *Truth*; it remains now that I ſhew, how the *Mind* may arrive to the ſame: Which that I may the more eaſily accompliſh, the following Points are heedfully to be minded.

Firſt, What *Cogitation* it ſelf, or *Perception* is, and what be the Modes of it.

Secondly, What be the *Objects* of our Perceptions, whether Univerſal or Singular.

Thirdly, How our *Mind* may arrive to the knowledge or Perception of Things, with reſpect had to the *Things* that are to be known; ſuch as are the *Common Attributes*, *Cauſes*, *Effects*, *Subjects*, *Adjuncts*, *&c.*

Fourthly, Whence the clearneſs and diſtinction of *Idea's* do depend, as likewiſe the Agreement and Diſagreement of Things.

CHAP. III.

Concerning the various Modes of Perception; viz. *Pure Intellection*, *Imagination and Senſe.*

I. *We muſt never give our Judgment of a thing unknown.* FOraſmuch as *Natural Inſtinct* teacheth us never to judge of a Thing unknown; and ſince nothing is known to us but what our *Mind* clearly perceives, we will firſt treat of the Nature of *Cogitation*, before we examine that of *Simple Notions*, to the end we may be able to diſcern what things are confuſedly, and what diſtinctly apprehended by us.

II. *What is to be underſtood by Perception.* By *COGITATION* in General, I underſtand all thoſe things which we experience in our Selves, and whereof we are Conſcious: Which Deſcription comprehends all the operations of our *Underſtanding*, *Will*, *Imagination* and *Senſes*; for to *Underſtand*, to *Will*, and to *Imagine*, is nothing elſe but to repreſent to our ſelves the thing whereof we have an Idea. And accordingly from theſe various ways of Perceiving, is deduc'd that firſt *Truth*, which we meet with in an orderly way of Philoſophizing: For becauſe I Think, that is, becauſe I Perceive, Imagine and Feel, it neceſſarily follows that I exiſt: And therefore that Propoſition, *I Think, therefore I am*, is of undoubted Truth; ſince it is impoſſible that I ſhould Think, and yet be Nothing. And ſo in like manner when I ſay, *I walk*, *I write*. Not as if *Walking* or *Writing*, which are perform'd by the Organs of the outward *Senſes*, did infer my Exiſtence, becauſe I may think I perform them in a Dream; but only becauſe the Conſciouſneſs which is in my Mind, of my *Walking* and *Writing*, could not be there without I did exiſt.

III. *Our own Exiſtence is before any other Truth.* I have ſaid, that this Propoſition, *I Think, therefore I am*, is the firſt Truth we meet with in our orderly Philoſophizing; becauſe the Exiſtence of our own *Soul*, which we gather from our *Cogitation*, is more known to us than the Exiſtence of any other Beings. For the *Thinking Mind*, which is underſtood by this word, *I*, doth know it ſelf before it knows any thing elſe; and the word, *am*, which imports the firſt Perſon, is before the word, *is*, which is only applied to the Third Perſon. For who is there who doth not firſt Think of himſelf as of a particular Being, before he doth of Man in general? It is natural to our Mind to think of a *ſingular* Being, which is propoſed to our Senſe or Underſtanding, before we think of a Being taken in *general*; and therefore this Propoſition may well be eſteem'd by us as a firſt Principle, ſince from this proof of our own Exiſtence, we confirm the Exiſtence of *God*, of *Material things*, and in a word, of all *Creatures* whatſoever.

IV. *It is impoſſible for the ſame thing to be, and not to be, is not the firſt Principle.* I am not ignorant, that this is commonly taken to be the firſt Principle, *It is impoſſible for the ſame thing to be, and not to be.* But I ſee not how this Propoſition can be of any uſe to us, in order to the attaining of Knowledge, ſince it doth not prove the Exiſtence of any thing, and doth ſeem to ſuppoſe that ſomething is, which ought to have been prov'd before. For it preſuppoſeth its Diviſion into *Ens* and *Non Ens*, or *Being* and *Not Being*; whence that Maxim is derived, *Every thing either is, or is not.* But our Principle, *I who think do exiſt*, preſuppoſeth nothing at all; and when all other things are liable to be queſtion'd and doubted of, yet it is abſolutely impoſſible, that *I who think* ſhonld not be ſomething; that is, that I ſhould not *exiſt*.

V. *Three Species or kinds of Perception.* There be Three Species of *Cogitation*; *Pure Intellection*, *Imagination* and *Senſe*: For by theſe Three Modes or Ways the Mind of Man *perceives* or *thinks*.

VI. *Pure Intellect.* The Mind is ſaid to *Underſtand purely*, when by her ſelf alone, and by turning into her ſelf, ſhe perceives a thing only by attending to the *Idea* ſhe hath of it; or when ſhe perceives a thing, whereof there is no Footſtep in the Brain. And in this manner the *Soul* apprehends things *Spiritual* and *Univerſal*, *Common Notions*, the *Idea of Perfection*, and finally, all her own *Thoughts*: Or likewiſe when it underſtands *Material things*, *Extenſion* with its Affections: For it is with the *Underſtanding* alone, that a Perfect Circle, a Thouſand Corner'd Figure, &c. can be conceived.

VII. *Imagination.* The Mind is ſaid to *Imagin*, when it applies its Knowing faculty to the Body, as intimately preſent with it; or when it applies it ſelf not to the Thing it ſelf, which is preſent to the outward Senſe, but to the Phantaſm impreſs'd by it in the Brain: As when it perceives a *Figure*, a *Circle*, a *Triangle*, the *Stars*, a *Machin*, *&c.* And theſe Perceptions are called *Imaginations*, becauſe the Mind by repreſenting theſe Things to her ſelf, doth form Images in the Brain; and foraſmuch as it cannot frame any Images of *Spiritual things*, it follows that neither can they be imagined.

VIII. *Senſe.* Laſtly, The Mind of Man, by *Senſe*, only perceives ſenſible Objects and things that are more obvious, as being preſent, and affecting the outward Organs. Thus it perceives *Steeples*, *Fields*, *Animals*, *&c.* and theſe Perceptions are called *Senſations*.

'Tis by theſe Three ways only that the *Mind* of Man perceives things: For whatſoever is repreſented to it is either *Spiritual* or *Material*; if Spiritual, it can be apprehended by the *Underſtanding* only; if Material, then it is preſent or abſent: If abſent, the Soul repreſents it to it ſelf by the *Imagination*; if preſent, it perceives it by Impreſſions made on the *Senſes*. So that there are only Three ways by which the *Soul* apprehends any

thing, *viz.* by *Pure Intellect*, *Imagination*, or *Sense*.

IX. *The Object of the* Understanding *is more common or general, than the Object of* Imagination.

Hence it is manifest, that the Object of the *Understanding* is of a larger extent, than the Object of *Imagination*: For by our *Understanding* we do not only conceive the Nature of *Spirits* and of a *Body* in general; but also the Proprieties of particular *Bodies*, which cannot be discovered by the *Senses*, nor by the *Imagination* neither, being only perceivable by the *Intellect*. Thus, tho' the *Understanding* perceives that the Diagonal Line of a Square, is to that degree incommensurable with the side of it, that tho' a Division into infinite parts should be supposed, yet we could never come to a Particle that might be the common Measure of them both: Nevertheless this Truth can never be reached by the *Imagination*, but rather seems repugnant to it: Because we can imagin nothing but some particular determinate Body, the *Species* whereof is impress on our *Brain*, as hath been said.

X. *No Corporeal Species are required to* Pure Intellection

And tho' the *Mind* doth sometimes contemplate Material and Corporeal things; yet it doth never admit any Corporeal Species, which are only received into the *Brain*, on which the Mind doth not depend in its Operations. For in order to Pure Intellection, we have no need of the *Brain*, but only for Sensation or Imagination. Whence it follows, that we can Understand many things which we cannot Imagin. I perceive by the Light of Nature *that GOD exists*, tho' I cannot represent him to my self by any Image. So likewise I have a clear perception of a *Chiliogon* or Thousand Corner'd Body; which yet I cannot imagin, that is, presentially behold its Thousand Sides; because the vast number of them confounds the Imagination. Now that I have a clear Perception of a Thousand Corner'd Body appears, because I can demonstrate many things concerning it, as that all its Angles together are equal to 1996 right Angles; which could not be, if I had only a confus'd Conception of it.

XI. Truth *or* Falshood *is not in the* Understanding.

It is to be noted, that no Error can be in the *Understanding* or *Imagination*, as long as they continue purely in the Contemplation of things: For if the *Idea* we have of those things it represents be conform with them, it is true; and if it disagree, then is it no representation of them. Moreover, since *Falshood* or *Error* consists in our attributing to a Subject what doth not belong to it, or denying of it what doth, it is plain that since the *Understanding* or *Imagination* do neither affirm nor deny, there can be no Falshood in them. Neither doth it contradict this, that the *Understanding* sometimes apprehends a False thing, as when it conceives a *Non Entity*, or Repugnant terms; as when the Mind conceives one that is no *Physician*, to be a *Physician*; in which Conception there can be no Falshood, because it truly conceives a Physician, tho' it apply that Conception to a wrong Subject.

XII. *But only in the* Will.

Wherefore all danger of Mistake is from our *Will*, when we give our Assent or Dissent to any thing we have not clearly perceived. Yet is not this to be understood, as if we did wilfully embrace Error; but because we do not restrain our Will sufficiently, but reach it forth to those things we do not perfectly understand. For it is another thing to be willing to be deceived, and to assent to those things in which *Falshood* is involved. And tho' few be so careless of themselves, as to desire to fall into *Error*, yet many are willing to give their Assent to those things in which Error is hid. For all Assent belongs to the *Will*, and is to be numbred amongst its Perceptions. For we see it is in our Power, tho' we perceive a thing, yet to suspend our Judgment, which restraint is the Determination of the *Will*; as likewise are *Desire*, *Aversion*, *Dubitation*, *&c.* For to the *Understanding* only belong *Pure Intellection*, *Imagination*, and *Sensation*.

XIII. *Sometimes the* Understanding *is the cause of* Error.

Since therefore *FALSHOOD* consists in the hasty Consent of the *Will*, it can by no means be imputed to the Intellect, because *Error* is not to be found in Perceptions, neither is it any way intelligible. Yet forasmuch as the *Understanding* commonly hath imperfect and confused Conceptions of things, it may be said to be an occasional Cause of our *Errors*. For as our Bodily Sight frequently leads us into Mistake, by representing Objects confusedly and imperfectly to us; so the *Understanding* having for the most part only a confused Perception of things, is a cause of the *Wills* falling into many Errors, by assenting to those things which are obscurely perceived by the *Understanding*.

CHAP. IV.

Of the Five Universals, or Predicables.

I. *There is a twofold Genus of* Beings *or* Entities.

WE are to suppose in the first Place, that there are *Beings* that have some reality in the Nature of things; and whose Attributes belong to them, whether the Understanding think so or not. Such are all *Substances*, and all *Attributes* or *Modes*, which denominate or vary them. Others again derive all the *Being* they have from the Intellect, on the operation whereof they so depend, as to vanish away upon its Cessation; as are all those which are called *Entia Rationis* (*Entities of Reason*) in the Schools.

II. Universals *are only Modes of Thinking.*

In the Second place we are to suppose, that nothing else is to be understood by the word *Universal*, than *that which agrees or is attributable to many things*; as the word *Substance*, which agrees to *Body* and *Spirit*. Wherefore all *Universals* are in our *Understanding*, and to speak properly, are only Modes of Thinking. For seeing all Natural things are Singular and distinct from each other, these *Universals* can have no Unity, but what our Understanding gives them. By Example, Two Lines if separately consider'd, cannot be said to agree in the Notion of a Line; because in the Conception of the one, is included the Negation of the other; wherefore to the end they may agree, we must first frame an Idea, which may serve us for the conceiving of all Lines that are like one another. Thus we put some Common Name upon all those things which are represented by an Idea, which Name is commonly called an *Universal*. And thus that famous Number of *Universals*, which hath rack'd so many Brains, may easily be salved.

III. *How* Universals *are formed.*

For Example, When we consider *Substance extended in Length, Breadth and Depth*, we frame an Idea of it, and call it the Idea of a *Body*, which afterwards is of use to us for the representing of all *Bodies* to our Mind. But seeing that many of them are distinguish'd by Species, as into *Living Bodies* and

and *Inanimate*, the Universal Name with relation to them is called *GENUS*. And since many of them differ only in Number; as *two Lines* of the same Magnitude, or two *Spherical Bodies*, we conceive an *Universal Idea*, which may represent all Lines that are measur'd by the same length, and all round Bodies contain'd within the same Surface; which *Idea*, with reference to them, as Numerically distinct, is called *SPECIES*, which is the Second *Universal*.

IV. *An* Universal *is considered as a* Whole, *or as a* Part.

Whence it follows, that one and the same *Universal*, with respect to the self-same Inferiour, may be considered either as a *Part*, or a *Whole:* For both the *Genus* in respect of the *Species*, and the *Species* in respect of the *Individuals*, is called a *WHOLE:* Thus *Animal* contains a Man and Beast. *Universals* also may be look'd upon as *Parts* of their Inferiours; so a *Man* is conceived as consisting of his *Genus* and *Difference*, that is, of an *Animal* and *Rationality*.

V. *The Original of* Difference *and* Proprium.

Neither hath the *Universal*, called *Difference*, any other Original; for when we consider that there is some difference between those things which we understand to be under the same *Genus*, or *Species*; we apprehend this variety under some common Notion, which we afterwards attribute to every Difference: As *Streightness* or *Rectitude*, whereby a Line is distinguish'd from one that is of another Figure. *Roundess*, whereby a Globe is distinguish'd from an Angular Body, &c. The *Predicable Proprium* is made, when we abstract one Notion from those that are peculiar to Things, and to which alone it agrees, and to no other: As *Partition* or *Divisibility*, and *Mobility* to a Body.

VI. *How the Universal called* Accident *is framed.*

Accident is framed by us, when after we have considered that many things may happen to, or be taken from Things, without the destruction of their Nature, we conceive the Idea of an *Entity* separable from them, which we call *Accident:* Which Name we make use of for the conceiving of all those things, which fortuitously happen to Things. And this is sufficient for the Explication of the Nature of *Universals*, especially to those who do not love to spend their time in vain Questions, or to confound the Notions of Things with fruitless Disputations.

VII. *The Partition of an* Universal *into five Species is a compleat Division.*

Now that this Division of an *Universal*, is *Adæquate*; that is, that there are neither more nor less Members of them than these Five, appears thus: The Idea which we frame in our Mind, and make use of to conceive many Things, either represents many Things distinguish'd by *Species*, and then it is *Genus*; or only Numerically distinct, and then it is *Species*; or it represents the Diversity, whereby many *Singulars* differ amongst themselves, and from other things, and then it is *Difference*; or the Property which belongs to them alone, and then it is *Proprium*; or some Contingency separable from their Essence, and this makes *Accident*, or the first and last *Predicable*.

VIII. *What* Predicables *are.*

These Five *Universals* are otherwise called *Prædicabilia*, *Predicables*, because they are *Modes of conceiving Universal Notions, which are affirmed of many things Truly, Properly, Naturally and Immediately.* They are said to be Modes of *Conceiving*, to intimate to us, that *Predicables* are Second Notions. For *Genus* is nothing in it self, but only with respect to those things with which it is compared; neither is there any *Species*, but with respect to the *Genus* to which it is subjected: neither can *Difference*, *Property* or *Accident* be conceived, but with relation to the Subjects they belong to.

CHAP. V.

Universals singly examin'd, as to their Nature, Properties, and Use.

I. *It is of use to take a review of these* Universals.

THough I have in the foregoing Chapter sufficiently made out, that there are Five *Universals* or *Predicables*, and that they are distinguish'd from each other by their Differences; yet I suppose it may be of use to give a more particular Explication of them, and set down how they are predicated of their Inferiours.

II. Genus *takes the first place amongst* Universals.

GENUS deserves the first place amongst *Universals*, both in order and dignity; for from it, as from their Head, the other Members depend and are maintain'd, and upon its ceasing perish and vanish. *Genus* therefore is *an Universal, which is predicated of many things distinct by Species, in the Question what it is.* As *Substance* is a Genus in respect of Substance extended, called a *Body*, and Substance *Thinking*, which is called a *Mind* or *Spirit*; and a *Quadrilateral* or *Square Figure*, is the Genus with respect to a *Parallelogram* and a *Trapezium.* To be predicated in the Question *What*, is when enquiry is made into the Nature of any thing, what it is. Thus when I enqnire what a *Body*, or what a *Mind* is, the Answer is properly made by their Genus, *viz. Substance*; and herein it differs from *Difference*, *Property*, and *Accident:* For tho' *Difference* be predicated by What, or Essentially, of those things whose Difference it is; yet it is not simply predicated so, but with the addition of *Quale*, which denotes the Form or Quality of a thing; and *Property* and *Accidents* are only predicated in *Quale*.

III. *What it is to be distinguish'd by* Species, *in the definition of* Genus

Wherefore in the foregoing Definition of *Genus*, to be distinguish'd by *Species*, is to differ Essentially, so as that some Essential part is found in the one and not in the other. Thus *Man* and *Beast* are said to be distinct by *Species*, because a Mind or Rational Soul is found in Man, which is not to be met with in a Beast.

IV. Genus *is twofold, one supream or the highest.*

Genus is twofold: One, the most General or Highest, which hath no *Genus* above it: As a Corporeal Being amongst extended Substances; and an Intellectual or Thinking Being, amongst those that are endow'd with Knowledge and Understanding.

V. *The other,* Subaltern.

The other *Genus* is called *Subaltern*, which intervenes betwixt the highest *Genus* and the lowest *Species*; or which with respect to the things above it is a *Species*, and with respect to the Inferiour is call'd *Genus*. Thus Living Thing, if it be referr'd to *Body*, under which it is sorted, is called a *Species*; but if to Animal, it is a *Genus*. And consequently, *Body* is a remote *Genus* of *Animal*, but Living Thing the nearest *Genus*.

VI. *What* Species *is, and how it is divided.*

The Second *Universal* is *SPECIES, which is predicated of many, only Numerically distinct in the Question, what a thing is.* By the last part of this Definition of *Species* we find it agrees with *Genus*, in that they both of them answer to the Question, what a Thing is: As when I ask, What is *Peter*? I answer aright by saying, that he is a Man.

Species

VII. *The Division of Species.* *Species* is twofold: The one called the Loweſt or moſt Special; the other, Middlemoſt or Intervening: The latter of which, tho' with reſpect to the Genus under which it ſtands, it be called *Species*; yet with reſpect to the Inferiours, of which it is predicated, it is a *Genus*: So Animal which is the *Species* of Living Thing, is the *Genus* in reſpect of *Man* or *Beaſt*.

VIII. *What the moſt Special, or Loweſt Species is.* The moſt Special, or the Loweſt Species, is that which is immediately predicated of *Individuals*: As Man of *Charles* and *James*; a Circle of all particular *Circles*: Which is therefore call'd the moſt Special or Loweſt Species, becauſe it hath no Species under it, but only *Individuals*. Wherefore alſo it is commonly defined, that which is predicated of Many, differing only Numerically in the Queſtion which asks, What a thing is?

IX. *How many ways* Difference *is to be underſtood.* The Third *Univerſal* is *DIFFERENCE*, which may be variouſly conſidered: Firſt, foraſmuch as it is the Conſtituent of *Species*; and then it may be defined to be *that whereby the Species doth exceed*, or is more worthy than the *Genus*: As Man exceeds an Animal or Senſitive Creature by *Rationality*. Secondly, As it is ſomething *Predicable*, and ſo it is commonly defined to be *an Univerſal, which is predicated of many different in Specie, in the Queſtion*, Quale quid, *or of what kind of Eſſence a thing is*. And this Definition agrees only to the intermediate *Difference*. Thirdly, Inaſmuch as it divides the Genus into differing Species; thus *Rational* and *Irrational* divide *Animal*, and conſtitute two Species, *viz. Man* and *Beaſt*. So the Equality of the Sides conſtitutes an *Equilateral Triangle*, and determines the Idea of a *Triangle*, which before was common to a certain *Species*. Fourthly, As it is an Eſſential part of the whole Compound, and ſo it makes a part of its Eſſence, and belongs to its Definition: Wherein it differs from a *Property* and *Accident*, as being an Actual part of the things to which it is attributed.

X. *The Species includes more than the* Genus. For in every *Species* there muſt neceſſarily be ſomething more than there is in the *Genus*; for otherwiſe there would be no diſtinction at all between the ſeveral Species, ſeeing they all agree in the Genus; and therefore if there be any diverſity betwixt them, the ſame is to be fetch'd from the *Difference*. For Example; The *Body* and *Mind* are two Species of Subſtance, and therefore it is neceſſary that in the Idea of *Body* there ſhould be ſomewhat more found than in the Idea of *Subſtance*; and the ſame muſt be ſaid of the Idea of the *Mind*. Now whereas the firſt thing we meet with in a Body, is *Extenſion*; and in the Mind or Soul, *Cogitation*; we may ſay, that *Extenſion* is the Difference of Bodies, and *Cogitation* the Difference of the Soul: Or in other words, That a *Body* is a Subſtance extended, and the *Soul* or *Mind* a Thinking Subſtance. Wherefore *Difference*, as it is the Third *Predicable*, may be thus defined: *That which is predicated of the Species, and of the things contained under it by the Queſtion*, Quale quid, *or of what kind of Eſſence the thing is.*

XI. *The fourfold diviſion of* Property. *The firſt Mode.* PROPRIUM is taken in a Fourfold Senſe or Acception: Firſt, *That which agrees alone to the Species, but not to all the Species*; that is, to all the Individuals reſorting under it. As, *to Cure by Art*, is attributable to Man alone, but not to all his Individuals.

XII. *The Second.* Secondly, *That which agrees to the whole Species*, but not to it alone. As it agrees to Man to walk on two Feet; for the ſame may be alſo ſaid of other *Animals* yet not of all. So *Diviſibility* is the Property of *Extenſion*, becauſe every extended Being can be divided; tho' *Duration* and *Number* be alſo diviſible.

XIII. *The Third.* Thirdly, *That which is attributable only and to the whole Species, yet not always, but only at a certain time:* As to grow grey-headed is peculiar to a Man; not in his Childhood or Youth, but in his Old Age: For if it happens otherwiſe, it is look'd upon as a Prodigy.

XIV. Proprium *in the 4th Mode.* Fourthly, *That which is attributable only, and to the whole Species, and at all times:* As it is the property only of a Circle, of every Circle, and at all times, that all the Lines drawn from the Circumference to the Center, are equal. And this laſt ſort of Property is that which conſtitutes the Fourth *Univerſal*; the other three Modes being rather referrable to Accidents, becauſe they do not agree neceſſarily, nor always, nor to the whole *Species*, but contingently, ſometimes and in part only. And thus *Proprium* in this laſt Senſe may be defined, *that which is predicated of many things by themſelves, and neceſſarily*, yet not eſſentially. I have added the word *Neceſſarily*, becauſe Property doth ſo agree with a thing, that it cannot ſo much as by Thought be ſeparated from it; foraſmuch as it is a neceſſary conſequent of its Eſſence, and is convertible with it. Thus it is the eſſential Property of a *Triangle*, that two of its Sides taken together, are bigger than the third, and that its three Angles be equal to two right ones; becauſe theſe do neceſſarily agree to a *Triangle*, inaſmuch as it is a Figure bounded by three right Lines.

XV. *What an* Accident *is, and how many ways it is taken.* In the laſt place, we call all that *Accident*, which is not *Subſtance*, neither doth neceſſarily agree to it, but doth only contingently follow the ſame; or is that *which without the deſtruction of the Subject may be preſent or abſent*. As *Roundneſs, Hardneſs, &c.* are common Accidents with reſpect to a Body, as *Sorrow* and *Fear* are Accidents with regard to the Soul or Mind. An *Accident* is twofold; *Separable*, which may eaſily be ſeparated from the Subject in which it is conceived to be, as *ſleep*, from Man; or *Inſeparable*, which cannot be ſeparated from the thing in which it is by the force of Nature, as *whiteneſs* from a Swan, *blackneſs* from a Blackamore: Tho' they may be abſtracted by Cogitation; for we can conceive a Swan without *whiteneſs*, and a Man without *blackneſs*. Wherein, as hath been ſaid, it is diſtinguiſh'd from a *Propriety*, which cannot ſo much as by Cogitation be removed from its Subject.

XVI. *The definition of* Accident *is true in a divided Senſe, not in a Conjunct.* When an *Accident* is ſaid to be preſent or abſent without the deſtruction of the Subject; this is not to be underſtood in a Conjunct Senſe, as if the ſame Accident could at the ſame time be preſent and abſent from the ſame Subject: But in a Divided Senſe, ſo as that the Accident which is now preſent may be abſent, and on the contrary. For it is a Contradiction that two oppoſit *Predicats*, ſhould at the ſame time be predicated of the ſame thing, though they may at divers times.

XVII. *The Series of* Genus's *and* Species To the end that the Order of the Higheſt *Genus*, and thoſe that are Subaltern, as alſo of the *Species*, may be the better known, it will be of uſe to ſubjoyn here a Series of *Univerſals*, by which we may be

be able to descend from the highest *Genus*, to wit, Substance, to *Individuals*; and remount back again from the *Individuals* to the highest *Genus*. For by this Scheme the Mind is much enlightned, and avoids that Confusion, which otherwise is apt to arise in the Defining, Dividing, and Enumerating of things.

A Substance,
Corporeal, Intellectual.
A Body,
Living, Void of Life.
A Living Thing,
Sensitive, Void of Sense.
An Animal, or
Sensitive Creature,
Endued with Mind, Void of Mind.
A Man,
This, Another, *Plato*.

XVII. *Which Series may be made after an Analytical way.*

The Words which follow from *Substance* to *Man*, are called *Intervening Genus's*, and those on the Right and Left are the *Differences*, which are said to be placed in an Indirect Line. From those words which are disposed in a Direct Line, we make the Series in a twofold manner; either by Analysis or Division descending, beginning from the Highest Genus, which is *Substance*, and distributing it, and all other the *Genus's* that resort under it, into their Species by their Difference, till we come to the Individuals. As if one should divide *Substance* into *Corporeal* and *Intellectual*; and then a *Body* into *Living* and *Void of Life*; and then a *Living Body*, into that which is Sensitive and devoid of *Sense*; and a *Sensitive Creature* or *Animal*, into that which hath a *Mind*, and which is destitute of it; and at last, an *Animal* endued with a Mind, *viz.* a *Man* into *Plato*, *Socrates*, *Aristotle*, *&c.*

XVIII. *Or by a Synthetical.*

The other is by way of *Synthesis* ascending, beginning from the *Individuals*, and from them mounting to the *Subaltern Genus's*, and lastly to the Highest Genus, *viz. Substance*. As when considering all particular Men, and finding them all to agree in the Nature of Man, we place *Man* as the Species above the *Individuals*. Then comparing *Man* with *Animals* or *Sensitive Creatures*, and finding in them the common Nature of *Animals*, we place *Animal* as the Genus above *Man*. Afterwards making a Comparison of an *Animal* with *Plants*, and finding them to agree in the common Attribute of Life or Living; we put *Living* above *Animal*: And then if we compare Living things with those that are destitute of Life, we shall find the common Notion in them both; and therefore place *Body* above *Living*. Lastly, If we compare *Bodily things* with *Angels* and the *Mind* of Man, we shall find the common Notion of Substance in them both; and therefore will place *Substance* as the Genus above Body, by which means *Substance* will be left the Highest Genus.

XIX. *What an Individual is, and its division.*

A *Singular* or *Individual* is opposed to an *Universal*, because it cannot be common to many Inferiour; as *this Man*, *this Sword*. It is twofold, either Indeterminate, which without difference may signifie this or the other *Individual*; as *a certain Man*, *a certain Woman*: Or *Signate* and Determinate; as *Julius Cæsar*, which is called Determinate by its Signification; or by Demonstration, as when a common Word is determined by a demonstrative Particle; as *this Colledge*, *this Court* or *Yard*: Or by Circumlocution; as the *Son of Sophroniscus* for *Socrates*, or *the Son of the Blessed Virgin* for *Christ*: And are therefore called by *Aristotle*, *Individuals*, *Singulars*, and Things differing in *Number*, because they cannot be divided as the foresaid *Universals*; and because we in a manner point at them, as if we were counting of them one by one, when we say *this*, *that*, *the other*, *&c.*

XX. *The first Use of Universals.*

Hence it appears what is the Use of *Universals*, and how far they conduce to the Knowledge of Things: For seeing that a thing considered under an *Universal Notion*, is a thing; as it is apprehended common to many Inferiours, or as it is predicable of many; we shall find that the consideration of *Universals*, is a great help to clear and distinct Perception, the obtaining of which is chiefly aimed at by all that is handled in this LOGICK. For by the help of these *Universals*, or *Prædicables*, we are enabled to discern the Attributes which constitute the Essence of a thing, from those which are Consequent to, and to know which are the *Properties* and *Accidents* of every thing: As for Example, it belongs to the Constitution of *Socrates* his Nature, that he be a *Man*, a *Sensitive Creature*, and *Rational*: Which Three in their Universality are distinguish'd; Man being the *Species*, Sensitive Creature or Animal the *Genus*, and Rational the *Difference*. Which tho' in *Socrates* they are all one and the same, yet are distinguish'd according to our Mode of Thinking. But the Faculty of *Laughing*, or *Laughter* it self, is consider'd as a consequent of *Socrates* his Essence, who is already constituted a *Man*, by his being an *Animal* and *Rational*. And the Faculty of *Laughing* is the *Property* of Man, but the Act of Laughing an *Accident*.

XXI. *The second Use of Universals.*

The Consideration of *Universals* is also of great Use to the more clear Perception of Things, whether they be Singular or Common. Of *Singulars*, whilst we enquire under what Species they are placed, what Genus's they have, ascending by degrees to the Highest. Of *Common* or *Universals*, when we examine what Differences they have, and what Species they contain, descending in this manner to the very Individuals. Thus by ascending, I know *Socrates* to be a *Man*, a Man to be an *Animal*, an Animal to be a *Substance*: And again by descending, I learn that Substance is either *Intellectual* or *Corporeal*; the Intellectual to be either *Infinite*, as *God*; or *Finite*, and that either without a Body, *viz.* an *Angel*, or joyned to a Body, as *Man's Soul*; under which Species the Mind of *Socrates*, as a Singular or Individual doth resort.

XXII. *Our Mind frames a general Idea two several way, the one by joyning or aggregating.*

The Second thing which follows from the Consideration of *Universals* is, that there are two ways of framing General Idea's, the one by *Aggregation*, the other by *Abstraction*. The Mind forms an Universal Idea by *Aggregation*, when it joyns many Singular Idea's of a like Nature together into one complex Universal Idea, which is called *Genus*. Thus making a Congeries or Collection of all Brute Beasts, as of *Lions*, *Horses*, *Bears*, *&c.* we find them all to agree in the Idea of a Brute Beast, which we therefore call the *Genus* of them.

XXIII. *The other by Abstraction.*

Again, we may form an Universal Idea by *Abstraction*, when we attribute the Attributes which constitute the Essence of a thing into several ranks or degrees, as if they were so many Parts. For tho' the Idea's of Singular things do agree in some one thing, yet they differ in more; wherefore when the *Mind* doth abstractedly and severally consider

things, in which many like Idea's are found; neglecting those wherein they differ; this abstract Consideration is called an *Universal Idea* or *Genus*. As for Example; If I take from *John*, *Peter*, *James*, all the Particularities that determine them, as that the one is a *Physician*, the other *old*, the third *young*, &c. and that I only consider them as being all *endued with Sense and Reason*: This affords me the General Idea of a *Man*, forasmuch as thereby not any particular Man is represented to me; but Man in Common, or the Nature of Man as such.

CHAP. VI.

Of Substance, and its Affections or Modes.

I. *The difference of our Perceptions.* THe difference of *Perceptions* or *Idea's* is taken either from the Things themselves which we understand, or from our different ways of Perceiving them, or lastly proceeds from the *Words* or *Signs* whereby we express our Notions. Now whatsoever is understood by us, is either conceived as a *Thing*, or *Substance*, existing by it self; or as the Attribute of a Thing, or Mode of *Substance*; or as something made up of a *Thing* and *Mode*; or a *Modified thing*; or lastly, *Propositions of Eternal Truth* residing in our Mind.

II. *What Substance is.* Substance *is a thing, which does not need any other Substance for its existence*; that is, which hath an Essence really distinct and separable from others. By this means is a *Substance* distinguish'd from an *Accident*, which is not really distinct from a *Substance*, nor can exist separate from it: Nay, an *Accident* cannot be clearly and distinctly conceived without a *Substance*, because its very Essence is to be in another; and nothing can be clearly and distinctly conceived without its Essence.

III. *Substance is known by its Attributes.* Tho' it be sufficient for the Explication of the Notion of *Substance*, to say, that it is a thing which exists independently of another; yet we cannot distinctly understand it, but by means of some Attributes that belong to it; and the more of these are found in any Substance, the clearer it is said to be known. For the *Attributes* or *Properties* of Things are, as it were, certain Forms that actuate them, and distinguish them from others: For we more easily know a Rational Soul, by conceiving it as a *Thinking* Substance, than as a thing *Existing*; because if it thinks, it must of necessity exist. So in like manner we have a clearer knowledge of a Body, by considering it as a Thing extended, than only as a thing existing, as is evident to him that considers it.

IV. *A Substance is either Created or Uncreated.* SUBSTANCE is twofold, *Created* or *Increated*. Increated is a Substance independent of all other things whatsoever, as GOD: A *Created Substance* is that, which tho' it do not stand in need of another Substance for its Existence, yet wants the Divine Concourse, without which it cannot exist; and therefore is not an absolute, but only a dependent *Being*.

V. *Created Substance is divided into Intellectual and Corporeal.* Of *Created Beings*, some are *Intellectual*, others *Corporeal*. An *Intellectual Being* is a Thinking Substance, as the *Mind* of Man: A *Corporeal*, is a Substance extended in Length, Breadth and Depth; or is the immediate Subject of Local Extension, and of all Modes that presuppose Extension, as *Magnitude*, *Motion*, *Figure*, *Position*, and all other such like, which cannot be conceived without Local Extension, as the foundation of them. And to the Mind or Soul belong all Acts or Modes of *Cogitation*, as to *Understand*, *Imagin*, *Feel*, and whatever else agrees in the universal Notion of *Cogitation*.

VI. *There be only two Genus's of Things.* Whence follows that there are only two *Genus's* or General Heads of Things, *viz.* of *Material* and *Intellectual*, or *Cogitative*: All others being reducible to these as *Modes* or *Affections*; now what these are, and how related to their Subjects, we shall next proceed to explain.

VII. *What an Attribute or Modus is.* There be many Attributes we may conceive in every thing; some of which constitute the Nature and Essence of a thing, and distinguishes it from all others; as *Extension*, which constitutes a Bodily Substance, and distinguishes it from a Cogitative Being: Others again presuppose the Nature constituted, and do only diversly affect or vary the same, as *Volition* doth the Mind, and *Figure* the Body; and these are called the *Modes* of *Substances*. Because tho' they affect or vary the Substance, yet it may be conceived without them, tho' they themselves cannot be understood but as inherent in some Subject; for herein properly the Nature of a *Modus* doth consist, that it cannot be conceived without including the Conception of the thing whose Mode it is. Thus I clearly perceive that a *Body* is an extended Substance, without Motion or Figure: But it is impossible for me to conceive Motion or Figure, except it be in an extended Being. So likewise I clearly perceive the *Mind* to be a Thinking Substance, without *Imagination* or *Sense*, because tho' these were absent it would be Cogitative notwithstanding: But *Sense* and *Imagination* cannot be conceived, but in a Cogitative Being.

VIII. *How Modes are distinguish'd from Aristotelical Accidents.* Wherefore a Modern Philosopher calls a *Mode*, the *Appendix of a Being*; because it cannot exist without the thing whose *Appendix* it is. Which we are to observe in opposition of those, who suppose that the *Modes* of things differ not at all from Real Accidents; forasmuch as these, according to them, may be conceived separate from their Subjects, and can exist so by the Divine Power: Whereas *Modes* can neither be separated from their *Subjects*, nor conceived without them; for otherwise they would be *Substances*, whose Nature it is to be Things subsisting.

IX. *What a Substance is.* *Substance* therefore is a thing that subsists by it self, and is the Subject of all the Attributes that are conceived to be in it.

X. *Whas a Mode is.* A *Mode* is that Attribute or Quality, which is conceived to be in the *Substance* it self, which determinates it to be such like. And this Mode is called by us an *Imperfect Being*, because it belongs to the Nature of it, that it cannot be by it self, and without some Substance in which it is; and whose *Being*, as the Schools express it, is nothing else but *Inbeing*; so that it is a contradiction for a *Mode* to be, and not to be or exist in a Substance. Wherefore neither can a *Modus* pass from the *Substance*, which is its Subject, and does support and uphold it, into another; for this would argue it not to have been dependent on the Substance wherein it was before, which implies a Contradiction.

XI. *The division of Modes into Internal and External.* Of *Modes*, some are Internal, others External: *Internal* are such as are conceived to be in the very Substances, as *Figure*, *Motion*, *Rest*, &c. *External* are such as depend on other Things, and are not in

in the Subſtances themſelves, as to be *Beloved, Deſired, &c.* which are Modes depending on the Action of another; and the Expreſſions we make uſe of to ſignifie the ſaid Modes, are called *Extrinſecal Denominations*; becauſe they only expreſs the Modes under which things are conceived.

XII. *What a thing Modified is.* A *Theng modified* is the Subſtance it ſelf, which is determined by a *Modus*.

XIII. *Theſe Three things explain'd by an Example.* As when I conſider a *Body*, the Idea I have of it repreſents to me a Body or Subſtance, becauſe I apprehend it as a Self-ſubſiſting thing, which needs no outward thing to its exiſtence: But when I conſider that Body *Round* or *Square*, the Idea which I have of its Roundneſs or Squareneſs repreſents nothing elſe to me, but a certain Mode of Exiſtence, which I find cannot naturally exiſt without a *Body*, to which the Roundneſs or Squareneſs belongs: And laſtly, when I joyn the Mode with the Thing, that Idea repreſents to me the Thing modified.

XIV. *Modes make no Compound of the thing whoſe Modes they are.* From what hath been ſaid, it follows, Firſt, That the *Modes* of Things are no hindrance to their Simplicity: For *Extenſion*, by Example, with the various Modes of Extenſion, as *Figure, Motion, &c.* is not a Compound, but a Simple thing. For that is ſaid to be a *Compound* which contains two, or more Attributes, whereof the one may be diſtinctly perceived without the other; and ſince the *Modes* cannot be conſidered without the *Subſtance* in which they are, it cannot be ſaid that they make a Compound of it. A *Simple Being* is that in which one only Attribute is found; whence it follows, that that Subject in which *Extenſion* alone, with its various Modes is underſtood, is a Simple Being; and that wherein we only apprehend the Cogitative Faculty, with the various Modes of *Willing, Underſtanding, Imagining*, is likewiſe a Simple Being: But that which comprehends both *Extenſion* and *Cogitation* is a Compound, *viz. Man*, who conſiſts of *Soul* and *Body*.

XV. *Subſtance is ſometimes conſider'd as a Mode.* Secondly, Hence it follows that a *Subſtance* may ſometimes be applicable to another in manner of a *Mode*. So *Cloaths*, when a Man is ſaid to be *Cloathed*, muſt only be called a *Modus*, notwithſtanding that they are Subſtances; becauſe Man is then conſidered as a Subject, to which Cloaths are added in the manner of a Mode.

XVI. *The diſtinction betwixt an Attribute, a Mode, and a Quality.* Thirdly, From what hath been ſaid we may gather, that we may conceive ſome difference between an *Attribute*, a *Mode*, and a *Quality*: As that an Attribute is that which is generally conceived to be in a Subſtance; ſo he who thinks of the Duration of the *Sun* doth contemplate an Attribute, under which the *Sun* is underſtood, foraſmuch as it continues in its being. And thus all Attributes are then diſtinctly underſtood by us, when we take care to affix no Conception of a Subſtance to them. We call that a *Mode*, which any way affects or varies a thing: So *Wax* is diverſified by Figures. And a *Quality* is that whence a Subſtance is denominated *Talis*, or ſuch like; as *Wax*, that is, *ſoft, cold, white, &c.* ſo *ſoftneſs* is the Quality of *Wax*.

XVII. *With what Names Subſtances and Modes are expreſt.* The Names whereby we expreſs Subſtances, are called *Nouns Subſtantive*, as *Mind, Body, &c.* The Names which expreſs Things modified, and which primarily and directly ſignifie Subſtances, and Modes indirectly, are alſo *Nouns Subſtantives*: As the *Earth*, the *Sun, &c.* But Words that primarily and directly, but confuſedly ſignifie Subſtances, and which indirectly, but diſtinctly expreſs Modes, are called *Nouns Adjective*; ſuch are *round, white, juſt, &c.*

XVIII. *What Propoſitions of Eternal Truth are.* The other things which fall under our Knowledge, are Propoſitions of *Eternal Truth*; which are not underſtood as Exiſting things, or the Modes of things; but as Eternal Truths abiding in our Underſtanding: As, *That which is, whilſt it is, cannot be nothing*: *I am, becauſe I think*: *What is once done, cannot be undone*; which are therefore called *Common Notions*, becauſe they are ſo ſimple and clear, that they cannot but be perceived by all Men. Neither muſt it be look'd upon as an Abſurdity, that we call any thing *Eternal* and *Immutable*, beſides GOD; becauſe we do not ſpeak here of Exiſting things, but only of Notions and Axioms which are in our Mind.

XIX. *The ſame are perceived by all, except their Prejudices hinder them.* Neither doth it hinder the Truth of theſe Propoſitions, that all of them do not appear equally evident to all Men; for the Reaſon of this is, becauſe they are not all conceived after the ſame manner, and conſequently not with the ſame Evidence. Not that I think the *Minds* of Men to be divers, and that the Knowing Faculty of one Man is larger than anothers; but becauſe probably theſe Common Notions may thwart the prejudicate Opinions of ſome Men, who therefore cannot ſo eaſily apprehend them; tho' others that are free from ſuch Prejudices, do perceive them with the greateſt Evidence.

CHAP. VII.

Of the Common Attributes of Subſtance.

I. *The Attributes by which Subſtance is known.* FOraſmuch as Things are underſtood by their *Attributes*, and are the more diſtinctly conceived by us, by how much the more Attributes we apprehend in them; I thought it needful to reckon up all the Attributes of *Subſtance*, that ſo nothing that belongs to the Nature of it, may be concealed from us.

II. *There are two Genus's of Attributes.* The Attributes of *Subſtances* are either Primary or Antecedent, or Originate and following from the Antecedent. The *Primary* are thoſe which are conſidered by us as certain Principles (not Effective, but Formal) as well of the Subſtance, as chiefly of all the reſt of the Attributes; ſeeing that when they are ſuppoſed, the others immediately follow, and are therefore called the *Principles of Being* or *Subſtance*; and they are two, *viz. Eſſence* and *Exiſtence*.

III. *Eſſence.* ESSENCE is the firſt Radical and inward Principle, Foundation, and Root of *Subſtance*, and all its Properties and Operations: For it is the Entity or Form whereby it is ſomething, and that which it is. Thus a Spiritual thing, ſuppoſe an *Angel*, by means of its Eſſence is not only a thing, but alſo ſuch a Being that is Intelligent, and not a Material Subſtance. And ſo likewiſe a *Body* hath not only from its Eſſence that it is ſomething, but alſo that it is Material, and void of Underſtanding. And therefore the *Eſſence* is by the Schools called, the *Metaphyſical Form*, becauſe it is the Chief thing whereby a Thing is diſtinguiſh'd from all others. When I ſay, the *Chief Thing*, it is not to be underſtood as if there were ſomething in Subſtance, beſides Eſſence, but only with reſpect to our Perception, which commonly proceeds by Parts, tho' the Thing it ſelf be Simple, without any Compoſition.

Having

IV. *Exiſtence.* Having inform'd our ſelves *what the Thing is* that is in queſtion, the next enquiry is, *Whether it be*; that is, whether ſuch a thing be to be found in the Nature of Things, to which the foreſaid Eſſence doth belong; and to this Queſtion *Exiſtence* belongs, by which a *Being* is ſaid to ſubſiſt, or by which the Eſſence is conſtituted in the Nature of Things: And therefore is called *Actus Entitativus*, an *Entitative Act*; as if Exiſtence were only underſtood by the operation or acting of Things. A Being in *Potentia*, or a *Poſſible Being*, is oppoſed to a Being in Act. So a *Lilly* in Summer is ſaid to be an *Exiſtent Being*; but in Winter, a *Poſſible Being*, *Ens in Potentia*; becauſe tho' it do not then exiſt, yet it is not repugnant to it, to be or exiſt in Time. Whence it appears that *Eſſence* and *Exiſtence* cannot be ſeparated from each other, ſince (to ſpeak properly) they are nothing elſe but two different Modes of Thinking: For we do otherwiſe conceive the Eſſence of a thing, when we abſtract Exiſtence or Non-exiſtence from it, than when we conceive it Exiſting. So when we apprehend *Poſſible* and *Actual Being* in one and the ſame thing, by different Conceptions, we do indeed conceive the thing as in a twofold State, but do not therefore divide it into more things. Thus the *Sun* that now appears in our Heaven, is the ſame that has continued from the beginning. Therefore the Power by which things that are not yet, are ſaid to be Poſſible, is called *Objective*; foraſmuch as ſuch Things are the Objects of ſome Cauſe, by which they may be produced in due place and time.

V. *Attributes Originate, or proceeding from others.* From theſe two firſt or primary Attributes, other *Attributes* follow, which are likewiſe common to all *Subſtance*, and are called *Originate*, or *Conſequent*; and are either *Abſolute*, which belong to the Subſtance conſidered by it ſelf; or *Reſpective*, which agree to the Thing with reference to others. The Abſolute Attributes are *Duration*, *Unity*, *Truth*, *Goodneſs*, *&c.*

VI. *Duration.* *Duration* is nothing elſe but an Attribute, under which the Exiſtence of Created Things is underſtood, with reference to their perſeverance in their Actual exiſtence. So that *Duration* agrees to all *Exiſtent Beings*, as long as they exiſt. With reſpect to *Duration*, ſome things are called Corruptible, and others Incorruptible. A *Corruptible Being*, is that which can periſh and ceaſe to be, or loſe the Exiſtence it hath: As the *Individuals* of every Species, which may be corrupted and changed into another Species. An *Incorruptible Being* is that, whoſe Exiſtence cannot be deſtroyed, and is either Simply ſuch, as *GOD*, who is *ſubject to no Change or Corruptibility*; or in certain reſpects only, which is preſerved by the *Power* of *GOD*, ſo as to ſuffer no diminution or increaſe. So *Matter* which continues one and the ſame in the World, is ſaid to be *Incorruptible*; tho' ſecond or ſingular *Matters*, as to their Forms, be ſubject to Generation and Corruption.

VII. *Unity.* Another Attribute of Subſtance is *Unity*, by which every thing is ſaid to be Undivided in it ſelf. Thus thoſe things are ſaid to be One, which are of the ſame Subaltern Genus or Species, becauſe they are conſidered by us under one and the ſame Notion, and for that we make uſe only of one Conception, to repreſent all thoſe Things to our Minds which agree together: And this Unity is called *Univerſal*. But *Singular Unity* appertains to thoſe Things, which without the Operation of our Mind are undivided, or to whoſe Nature it is repugnant to be divided into more *Entities*; whereby is verified that Common Saying of the *Philoſophers*, That *whatſoever is, is Singular*; becauſe that which is not One, cannot be eſteemed to be. Some Things again are *One* by themſelves, and others by Accident: Things *One by themſelves* are ſuch as have an Undivided Nature, whether they be Simple or Compound. For the multitude of Parts is no hindrance of *Unity*, ſo the Parts, which conſtitute a Third thing, be but cloſely joyned together. For *Man* is ſaid to be One by himſelf, notwithſtanding that he conſiſts of Parts of a different Nature, and ſeparable from each other. Whereas thoſe things are called *One by Accident*, which conſiſt of diſjoynted Parts, and between which there is only a very ſlight Union. So an *Army* is called *One Body* by Accident, becauſe it conſiſts of a great number of Men joyn'd by an Imperfect Union.

VIII. *Truth.* In Subſtance we alſo conſider *Truth*, which is commonly called *Metaphyſical*, or *Tranſcendental*; and is nothing elſe but the correſpondence of the Name with the Thing ſignified by it. For in this Senſe the Nature and Eſſence of every thing may be ſaid to be *True*. So that to *enquire into the Nature* of any Thing, is the ſame as to ſearch what a Thing is, and of what kind it is: And to *find out Truth* is nothing elſe, but to comprehend whether a Thing be, and of what Nature a Thing is. Wherefore, ſince it is not in the Power of Creatures, to change the Natures and Eſſences of Things, no more than they can *Eternal Truths*, it follows, that there is nothing oppoſed to *Tranſcendental Truth*. For tho' *Juſtice* be oppoſed to *Injuſtice*, *Truth* to *Falſhood*, and *true Gold* to *falſe Gold*; yet the Things which are oppoſed to *true Vertues* have no Nature, neither have we any poſitive Idea of them: For that which is oppoſite to *true Gold* hath no Eſſence at all; and in like manner, that which is contrary to *True Faith*, or *True Fortitude*, is

IX. *What things are ſaid to be true Metaphyſically.* To *Metaphyſical Truth* are referred not only thoſe Things which have, or may have an Exiſtence without the Intellect, as all *Natural Beings*; but alſo whatſoever is Poſitive, and conſequently hath an Eſſence or Nature, tho' it have no Exiſtence without the Intellect. For not only thoſe Things which are the Object of our Senſes, as *Heaven*, *Earth*, the *Sea*, *Sound*, *Colour*, *&c.* do enjoy a True and proper Eſſence; but *Fortitude*, *Juſtice*, *a right Line*, *a Triangle*, *Cauſe*, *Effect*, and in a word, whatſoever we apprehend as Poſitive, or in the manner of an *Entity*. For we ſay, *True Juſtice*, a *True Triangle*, *&c.* becauſe their Nature is True, and becauſe we can demonſtrate many things of them; as of *Juſtice*, that it *gives to every thing its own*: Of a *Triangle*, that its *three Angles are equal to two Right ones*.

X. *Goodneſs.* *Goodneſs* follows *Truth*, and is likewiſe reckoned amongſt the General Affections of Subſtance: For if a Thing have that Eſſence which it ought to have; that is, if it be *True*, it muſt of neceſſity be *Good* alſo. And therefore we frequently confound the Denominations of *True* and *Good*; as when we call a *True Syllogiſm*, *Good*, becauſe the thing which agrees with our Underſtanding, cannot diſagree with our Will, in caſe the Will be right, and

and that it be carried towards it after clear Perception. Thus GOD, after he had Created the *World*, and all things contain'd in it, he declar'd them all to be *very good*, becauſe they agreed with the Idea's he had of them, and therefore were ſuch as he would have them to be. Wherefore *Ariſtotle* defines *Good* to be that *which all do deſire*; foraſmuch as nothing is deſired, but what agrees with the Will. As there are many degrees of *Truth*, ſo alſo of *Goodneſs*, whilſt we account ſome more excellent than others, which we more eſpecially do, when we meaſure the *Goodneſs* of any thing from its Actions, or the ſtrength and force of its Acting. Thus we ſay, that the *Mind* excels the *Body*, and the *Fire* the reſt of the Elements.

XI. *Relation.* Thus much for the Abſolute Attributes of *Subſtance*; we proceed now to the *Relative*, which agree to a Subſtance as related to another, and not as conſidered in it ſelf. Now *Relation* is nothing elſe, but a Mode of our Underſtanding, comparing one thing with others, becauſe of ſome Properties or Acts that are found in them: So a *Father* is Related to his *Son*, becauſe he hath begot him; and the *Son* to his *Father*, as being begotten of him. If we conſider a *Father* and *Son* Materially, without their Relation, we ſhall call them *Subject*; but if we conſider them with reſpect to one another, we ſhall call the one the *Relate*, and the other the *Correlate*; becauſe as the Father is related to the Son by *Paternity* or *Fatherhood*; ſo is the Son to the Father by *Filiation* or *Sonſhip*. Upon which account it is that *Relatives* are ſaid to be or exiſt *Naturally both together*; becauſe you cannot ſuppoſe the one, without ſuppoſing the other: For ſuppoſing a *Husband*, you muſt ſuppoſe a *Wife* too; and ſuppoſing a *Maſter*, he muſt have a *Servant*.

XII. *Relation is manifold.* *Relation* is manifold; *viz.* a Relation of *Origination*, of *Negation*, of *Affirmation*, of *Compariſon*, of *Compoſition*, of *Acceſſion*, and of *Subſtitution*.

Relation of *Origination* is, between a Principle and that which proceeds from it; as between the *Day-break* and a *Day*, a *Point* and a *Line*, a *Subſtance* and its *Properties*.

Relation of *Negation*, is between diſtinct Things, or between Things going before, and thoſe that follow after. The former of theſe is called a Relation of *Diſtinction*, the latter a Relation of *Order*.

Relation of *Affirmation* is, whereby one thing is affirmed of another.

Relation of *Compoſition*, is between the Whole and the Parts, the Simple and the Compound, the Perfect and Imperfect.

Relation of *Acceſſion*, is between the Subject and the Adjunct.

Laſtly, *Relation* of *Subſtitution*, is that which intervenes betwixt the Sign, and that which is ſignified by it; the Meaſure and the thing Meaſured; the Image and the Original.

XIII. *Oppoſition.* As one *Subſtance* is related to another, ſo likewiſe it is oppoſed to another: As when we ſo conceive of Two things, as that they cannot conſiſt together. So *white* and *black Things* are ſaid to be oppoſed, and theſe are called *Contraries*, becauſe the Eſſence of one is different from the Eſſence of the other; yet not wholly and altogether, but becauſe there is ſomething in the Nature of one of them, which is not in the other. Thoſe things are called *Diſparate*, or *Diſagreeing*, when one thing is oppoſed to many after one and the ſame manner: As *white* is oppoſed to *green*, *yellow*, *blew*; becauſe *white* is not only oppoſite to *green*, but alſo to *yellow* and *blew*, and all Middle Colours. But when one *Oppoſite* altogether denies the other; as *a God*, *No God*; they are commonly called *Contradictories*. And this is the greateſt of all Oppoſitions, foraſmuch as it denies every where, and always. But if it deny the ſame only in a certain Subject, as *Sight* in a Senſitive Creature, then they are called *Privative Oppoſits*: Becauſe by Privation is underſtood the abſence of ſome *Entity* in a Subject capable of receiving it, as *Blindneſs in the Eye*, which is capable of *Sight*.

XIV. *Order.* *Order* is another Attribute of *Subſtance*, conſiſting in firſt and laſt, or former and latter. It is various, according to the diverſity of *Place*, *Time*, *Dignity*, *Knowledge*, and *Perfection*, which we conceive to be in things. *Order of Knowledge*, is taken from the Things themſelves; and by this *Cauſes* are before *Effects*; *Simple Terms* are more known than *Complex*. *Order of Dignity*, is fetch'd from the Eſſence of things; thus the *Mind* is more worthy than the *Body*: Or from *Accidents*; thus a *King* is more worthy than his *Subjects*, a *Maſter* than his *Servants*. A Thing is ſaid to be before another in *Nature*, whoſe Eſſence doth precede the other; or from whoſe Exiſtence the latter is not inferr'd, but on the contrary: So an *Animal*, or a *Senſitive Creature*, is ſaid to be by Nature before *Man*; becauſe tho' an Animal exiſt, it doth not therefore follow that a Man exiſts; yet when a Man exiſts, it follows that an Animal exiſts alſo.

CHAP. VIII.

How the Name of Subſtance *agrees to GOD and the Creatures.*

I. *How many ways Names agree to a Thing.* FOr the better clearing of this Difficulty, we are to ſuppoſe with *Logicians*, that a Name may after divers manners be communicated to a Thing. Firſt, *Univocally*, when it agrees to many Things for the ſame Reaſon; as when the name *Triangle* is given to all Figures contained within three Lines. *Equivocally*, when we call many things that are Eſſentially diſtinct by the ſame common Name, for divers Reaſons: As when in Latin we uſe the Name *Gallus*, to ſignifie a *Cock* and a *Frenchman*; or when we uſe the word *Parabola*, to ſignifie an *Allegory*, or *Similitude*, and a *Geometrical Figure*. *Analogically*, as when we give the ſame Name to many Things; but to one Principally, and to the other Secondarily: As when we ſay that an *Animal*, a *Pulſe*, and *Phyſick* are Healthful; for *Health* principally and chiefly agrees only to an *Animal*, to the *Pulſe* as it is a ſign of it, and to *Medicine*, becauſe it procures it. Having briefly obſerved theſe things,

II. *The Idea of Subſtance does not agree Univocally to GOD and the Creatures.* I ſay, Firſt, that the Name of *Subſtance* doth not agree to God and the Creatures *Univocally*. Which I prove thus: Different *Participation* deſtroys *Univocation*; but *God* and the *Creatures* participate the Name of *Subſtance* after a different manner therefore. The Minor is proved, becauſe *God* is a Subſtance Independent of any other; but all other *Creatures* are Subſtances dependent of

Him: GOD alone is He, who needs no other to his Existence; but all *Creatures* stand in need of the Divine Concourse for their Existence, neither can they without it be conceived to exist in the Nature of Things.

III. *The same expresst in other words.* Or otherwise thus: The Idea of *Substance*, is the conception of a Being subsisting of, or by it self; but there is no *Creature* so exists by it self, as to be sufficient for its own Existence, or so Powerful, as to be able to keep and preserve it self: Wherefore the Name of *Substance* cannot *Univocally* agree to *God* and the *Creature*.

IV. *A Being from himself and from another, are absolute Differences.* And if with more attention we consider the Matter, we shall find that *God* and the *Creature* do not agree in the Idea of any Genus whatsoever; and that the word *Being*, *Ens*, which is commonly by *Logicians* attributed to *God* and the *Creature*, is perfectly *Equivocal*; and that the *Equivocation* is not more plain in the word *Dog*, when attributed to a *Constellation* in Heaven, and to a *Beast* on Earth; or in the Latin word *Jus*, which signifies *Law* or *Right*, and *Broth*, than in the word *Ens*, or *Being*, when given to a Being which is of it self, and to one that is from another and altogether dependent. For to exist of ones self, or to be made by another are meer *Differences*, which do not admit any common Genus; and as *God* is distinguished by the former, so are all *Creatures* by the latter: *God* being a purely Self-existent and Independent Being, and the *Creatures* purely dependent Beings, and existing from another.

V. *God is above Substance.* Wherefore S. *Denys* calls GOD *Super-substantia*, and *Super-ens*, (*Above-substance*, and *Above-entity*) because he is raised above all Substances, and separate and distinct from all other Things whatsoever. Accordingly he that would make a true Scheme of the *Predicaments*, must set down *Ens à se*, or a *Self-existent Being* by it self, and distinct from the Series of other things; and afterwards *Ens ab alio*, or a *Being* that is from another, as the Original of *Differences*, placing at the Right hand of it *Intellectual*, and on the Left *Corporeal*, and then put the next Division of *Things*. Because the Name of *Entity*, or *Being*, only agrees with the Being, which is of it self, and can only Equivocally be assigned to *Creatures*, that have their Being from another.

VI. *An Objection answer'd.* If any one say, that the word *Substance* agrees in common both to *God* and the *Creatures*, and that all the Inequality that is found in them doth arise only from the *Differences* of it? I answer, That this is not true, forasmuch as Dependency is involved in the Essential Conception of a Creature. Now it is required to the Nature of *Univocal Words*, that they be equally communicable to all, and not to one Primarily and to the other Secondarily, or with dependance on the First.

VII. *The Idea or Notion of* Substance *is Univocally competent to Creatures.* I say in the Second place, that the word *Substance* doth *Univocally* agree to all Creatures. For all *Creatures* are conceived under this Common Notion, that all of them stand in need of the Divine Concourse for their Existence. Now that Name which is attributed to many for the same Reason, and equally participated by them, is *Univocal*; therefore the Name of *Substance* is distinctly understood to be Common to all *Creatures*, according to the property of *Univocals*.

VIII. Having thus explained these Things, I think I have with one and the same labour explained all *Metaphysicks*, concerning *Entity* and its Affections; yet that no Body may complain, that the same has been left out in this *Institution*, seeing the consideration of it doth indeed belong to *Logick*, I shall subjoyn here such a Genealogy of *Things* and *Modes*, by means of which the Student of *Philosophy* may, as it were at one View, contemplate the whole University of Things. *Why the Genealogy of Things and Modes is here annexed.*

The Fifth Rule of Truth.

It avails much to the clear and distinct Perception of Truth, *to retain in ones Mind an accurate Genealogy of* Things *and* Modes, *that with one cast of an Eye we may be able to take a view of the whole Universe of* Things, *beginning from the most General, and ending in the most Special.*

IX. *The Use of the foregoing Rule.* The Reason is, because this will be a great Help towards the thorough Knowledge of Things, as pointing us to what *Tribe* they do belong, what Affinity they have with some, and what Difference from other Things; neither will it be of less Use to us in the *defining*, *describing*, and *distributing* of Things. And to the end you may have a short Compendium at hand, of all those Things in general, which fall under the Perception of our Mind, and consequently also of those *Idea's*, which the Mind forms to it self, whilst it beholds them: Behold I here furnish you with such a *Genealogy*, as contains all and every one of the *Genera* of *Things* and *Modes*, each in its proper order and degree.

The Genealogy of Things and Modes.

Whatsoever falls under the clear and distinct Perception of our *Mind*, is somewhat.

And that Somewhat, is either { A *Thing*, *A* / or, / The *Mode* of a Thing, *B*

I. A *Thing*, (or an *Entity* or *Substance*, for they are Synonymous) is something which hath an Essence and Existence distinct from all other Things. *Essence* is the Natural and Invariable Constitution of the Thing, by which it is that which it is. *Existence* is a Consequent upon the Essence of a Thing, by which it now actually is, or is the *Essence* it self now existing in the University of Things. The Consideration whereof belongs to Ὀντολογία, by some called *First Philosophy*; and by others *Metaphysicks*, which treats of Things Universally, and therefore also is called *Catholick*, or *Universal*. *A.*

A Thing or Substance in General, is twofold { *Thinking*, *a* / or, / *Extended*, *b*

Thinking, or a Mind is either { 1. Infinite, as *GOD*, whence is *Natural Theology*. / 2. Finite, as the Mind of { an *Angel*, whence is *Angelography*. / a *Man*; whence *Psychology*. } *a.*

This part of the Genealogy of a *Thinking Substance* is handled in *Noëtica*, that is, *Pneumatica*, as others term it; the Parts whereof I have just now mentioned.

A Thing Extended, or a Body, is twofold. *b.*

I. An *Element*; that is, a Principle whence other *mix'd Bodies* have their Original, and into which they are resolved again at last. Which again is Threefold.

1. *Subtil*

1. *Subtil Matter*, which constitutes the *Stars*.
2. The *Heavenly Globular Matter*, whence the *Light* and *Heavens* are.
3. The *Grosser Particles of Matter*, whence are the *Planets* and *Comets*.

II. *Elementatum*, or *Principiatum*; that is, all those things that have their Original from the *Elements*.

And these are again Twofold:

I. *Without Life*, or *Concrete*; which branch themselves into,

1. *Simple Concretes*; as the *Heaven*, which consists of the *Globuli* of the Second Element; and the *Stars*, of the Matter of the First Element.

2. More *Compound Concretes*.

1. Those on high, as *Planets*, *Comets*, &c.
2. Those beneath, as *Fire*, *Air*, *Water*, *Earth*, and things consisting of these: As,
   1. *Meteors*, as *Vapours*, *Wind*, *Rain*, *Snow*, *Hail*, *Thunder*, &c.
   2. *Fossils*; that is, *Minerals*, *Metals*, and *Stones* — *Common*, or *Precious*.

II. *Living*, or *Animated*.

1. Without Sense, or *Vegetable*, As all kind of *Plants*, whether — *Herbs*, *Shrubs*, or *Trees*.
2. Endowed with Sense; as an *Animal*,
   1. Rational, as *Man*.
   2. Irrational, as a *Beast*.

This Part of the Genealogy, concerning *Extended Substance*, or *Body*, is unfolded in *Physiology*, or *Natural Philosophy*, which is also called *Somatica*.

B. II. The *Mode*, (that is, the *Attribute*, *Affection*, *Accident*) of a Thing, is somewhat of an *Entity* or *Being*, that is and exists by the assistance of another thing.

These are Twofold, General, *a* or Special, *b*

a. I. *General*; Such are the Modes or Attributes of all Things in General, commonly called *Transcendentals*: As,

1. *Unity*; by which every thing is always one and the same, and Undivided. *Multitude* is a Collection of *Unities*.
2. *Truth*; by which a thing is conformable to its Idea. *Falsity* contrariwise.
3. *Goodness*; whereby it is fit for Use.
4. *Perfection*; whereby it is whole and entire, and hath whatsoever it ought to have.
5. *Locality*; whereby it is every where, as *God*; or somewhere, as all other Things besides *God*.
6. *Duration*; whereby a Thing continues in its Existence either always, or for a certain time:

As *Eternity*. As *Time*: Present, Past, Future.

These Things are explained in the *First Philosophy*, or *Metaphysicks*, which treats of Things, and of their Modes and Affections Universally.

b. II. *Special*; Such are the Modes or Attributes of Things in *Specie*.

(1) For the Division of Things: As,

1. The *Modes*, that is, the Attributes of a Thing Cogitating: As, *Intellection*, and *Volition*. *Power* to act of it self, Αὐτοκρατία.

2. The Modes or Attributes of a *Thing extended*, or *Corporeal*:

As
1. *Quantity*, or *Magnitude*; which *Mathematicks*, or *Posotica* treats of.
2. *Figure*, or the different Termination of *Magnitude*, handled in that Part of *Mathematicks*, which is called *Geometry*.
3. *Situation*, or the certain Position of a Thing in Place and Space.
4. The *Quiet* or *Rest* of the Parts of any Thing.
5. *Local Motion*, or the Variation of Situation, whence proceed Active and Passive Qualities; as *Rarity* and *Density*, *Fluidity* and *Hardness*, *Heat* and *Cold*, *Moisture* and *Dryness*, and the rest; which are treated of in *Natural Philosophy*.

(2.) From the Conjunction of a thing: *Thinking* and *Extended*, result the following Modes and Affections.

1. The Appetite of *Hunger* and *Thirst*.
2. The Senses: Internal; *Phantasy* or *Imagination* and *Memory*. External; *Seeing*, *Hearing*, *Smelling*, *Tasting*, and *Feeling*.

And their Affections, as *Waking* and *Sleep*.

3. The Affections or Passions; as *Love* & *Joy*, *Hatred*, *Sorrow*, *Hope*, *Fear*, and the several kinds of them, which are also handled in *Physiology*.

X. *The Scope of a Philosopher is, to know the Natures of Things.*

Hence we may gather in the first place, that *Philosophy* considered in all its Parts, is nothing else but a Scientifical Explication of this or a like Genealogy. For a Philosopher pretends nothing else, and is content with this alone to understand the Natures of Things, to know their Forms, Differences, Affections, and that from the nearest Causes, if the *Mind* can reach them. Now this will hardly be obtained by him who is not well vers'd in the Genealogy of Things.

In the next place, That this Genealogy is abundantly sufficient to supply the place of the Common Categories and Predicaments of the *Aristoteleans*.

XI. *What the Peripateticks understand by Predicaments.*

By *Predicaments* and *Categories*, they understand such a Series and Disposition of Things, in which the Superiour is always predicated, that is, affirmed Univocally, that is, according to Name and Thing, of its Inferiours in the same *Predicamental Line*. Taking this for granted, as a thing known to all Men, there are many things which I cannot approve of in the Constitution of those *Predicaments*.

XII. *What is to be disproved of in the Categorical Series.*

First, That they divide *Ens* into Substance and Accident without any Reason: Forasmuch as an *Accident* is no *Entity*, as appears from the foregoing Definition of *Ens* (*A.* I.); but rather is something belonging to an *Ens*, according to (*B.* II.)

Secondly, In that they constitute Nine supream *Genera* of Accidents, which they thus reckon up; *Quantity*, *Quality*, *Action*, *Passion*, *Relation*, *When*, *Where*, *Situation*, and *Habit*.

Where first they mistake in this, that they make those to be the Supream *Genera*, and distinct too, which truly are not so; as *Quantity*, and *Quality*: For the greatest part of *Physical* or *Natural Qualities* arise from *Quantity*, *Figure* and *Motion*. Secondly, *Relation* doth not in the least belong to the Genealogy of Things, because it is no

no absolute thing, but only an Affection framed by Reason, *viz.* an *Opposition*, with or under some respect. Thirdly, *Action* and *Passion* in Bodies are reducible to Motion, whose Species or Modes they are. Fourthly, The Division of *Ens* into Substance and Accident, invented by *Aristotle*, deviates from the Rules of a good Division; because the Parts of it are not opposite. Fifthly and lastly, If any true *Attributes* of Things be found amongst them, the same may be more fitly deduced from our Genealogy: As for Example, *Quantity* belongs to the first Mode of an Extended Being: *Quality*, if it be Mental, to the Modes of Intellection and Volition; if it be Physical, or Corporeal, to the Fifth Mode of an Extended Being, or to others: *When* and *Where*, to Duration and Place, which are the General Attributes of Things: *Situation* is the Mode of an Extended thing, or the respect of one Body to others, considered as near to it: And *Habit* is the Common Adjunct or Accident of some Things; as of a *Human Body*, or some other.

CHAP. IX.

Of the Whole and Parts, Causes and Effects, Subject and Adjunct.

I. *Some other things necessary to be known in order to clear Perception.* HAving thus Explained the *General Attributes* of Things, as far as is sufficient for the Knowing of Things in General; if any one further desire to Know Things more distinctly and evidently in *Specie*, and particularly, he must consider the thing either as a *Whole*, consisting of *Parts*; or as an *Effect*, produced by *Causes*; or as a *Subject*, furnish'd with various *Attributes*. For this will be a great furtherance to attain a clear and distinct Knowledge, that is, Perception of any Thing.

II. *The Order of Things here to be treated of.* It follows therefore, that we explain the Notions of a *Whole* and its *Parts*, of a *Cause* and its *Effects*, of *Subject* and *Adjunct*; because from these Notions, the Idea of every thing is absolutely and to the Life expres'd in the Mind of him that Thinks.

III. *What a Whole is, and how manifold.* We call that a WHOLE, which consists of many things joyned together, or which hath *Parts*, into which it may be divided: For a thing which wants *Parts*, is improperly called a *Whole*. Wherefore the *Aristotelians* are in a Mistake when they say, that the Mind of Man is *Whole in the whole Body, and Whole in every Part*; because the *Mind* being an Intellectual Substance, is without *Parts*, and after an Indivisible manner in the Body. Wherefore also an Immaterial Substance cannot be said to be *Whole*, save only Negatively, inasmuch as it doth not admit of Parts, or Division. A *Whole* is threefold, *Essential*, *Integral*, and *Universal*. An *Essential Whole*, is that which consists of Parts, whereof the one is in the other, as are *Matter* and *Form*: Thus Man consists of *Soul* and *Body*. An *Integral Whole*, is that which hath Parts without each other; as a Man's *Body* consists of *Head*, *Hands*, *&c.* An *Universal Whole*, is any Genus with respect to its Species; as *Animal* respecting Man and Beast: Or a *Species*, referring to its Individuals; as *Man* to to *Socrates* and *Plato*.

IV. *What a Part is, and how manifold.* We call that a PART, which together with its *Copart*, or with many of them, doth constitute a *Whole*; as the *Soul* and *Body* make a Man. A *Part* is either Principal, without which a *Whole* cannot consist; as is the *Head* in a Human Body: Or *Less Principal*, which when sever'd doth only maim the whole, but not destroy it.

V. *What is meant by the word Cause.* Tho' the Word CAUSE be of it self sufficiently known to all, and therefore the Explication of it seems superfluous; yet is it commonly defined, *That from whose Being something else follows*: Or, *That which of it self, influenceth something different from it self*. Accordingly, GOD the *Father* is the Principle, but not the Cause of the *Son*; for the Son is another Person from the Father, but not another Thing, that is, not of another or different Nature.

VI. *The division of Causes.* There are Five *Genera* or kinds of *Causes*, *viz.* the *Material*, the *Formal*, the *Efficient*, the *Exemplary*, and the *Final*.

VII. *What the Material Cause is.* The *Material Cause*, is that out of which things are made or formed; as *Wax* is the Matter of which *Tapers* are made; *Pewter*, the Matter of which *Pots* are made; *Gold*, of which *Guinea's* are made. So that whatsoever is agreeing or disagreeing with the Matter, the same also agrees or disagrees with the Things that are made out of it.

VIII *What the Formal.* The *Formal* is that which Constitutes another thing and distinguisheth it from all other; as the *Soul* is the Form of Man. But whether the Forms of other things be *Physical Entities*, as they talk in the Schools, or only a disposition of *Parts*, shall be discoursed in the General Part of *Physiology*, where this Point shall be distinctly handled. Both these *Causes* are called *Internal*, because they abide in those Things whose Essence they do constitute.

IX. *The Efficient.* The *Efficient*, or *Effecting Cause*, is that which produceth another thing; and the same is manifold.

X. *A Total Cause.* *Total* or *Adequate*, which alone doth produce the Effect, excluding other Causes of the same Rank; as *God* creating *Adam*, whom he produc'd without the Concourse of any Other.

XI. *Partial Causes.* But a Father and Mother, or Male and Female, are said to be *Partial Causes*, with respect to the Child they generate; because they need each others assistance, and can do nothing solitarily.

XII. *Proper and Accidental Causes.* The *Sun* is the *Proper Cause* of *Light*; but only an *Accidental Cause* of the Death of a Man, who is kill'd by too great Heat; because the bad Constitution of his Body, was the occasion of his being hurt by the Heat of the *Sun*.

XIII. *The Near and Remote* A Father is the *Near Cause* of his Son; but a Grandfather the Remote.

XIV. *The Effective Cause.* A Mother is the *Effective*, or *Productive Cause* of her Son, because she effects a thing which before did not exist.

XV. *The Conserving Cause.* A Nurse is only the *Conserving Cause*, because she only effects the Continuation of its Existence, and lends her assistance that it may continue in that Existence, which it hath received from its Parents.

XVI *An Univocal Cause.* A Father is an *Univocal Cause*, with respect to his Children; becuse they are of the same Nature with him.

XVII. *An Equivocal Cause.* But GOD is only an *Equivocal Cause*, with respect to his Creatures; because they are of a different Nature from His, and in Dignity inferiour to him.

XVIII. *A Principal Cause.* An Artificer is called the *Principal Cause* of his Work, because he acts voluntarily; but *Instruments*, because they are managed by him, as means subservient to the performing of his Work, are only said to be *Instrumental Causes*: Because tho' there be some kind of Power to work in the Instruments, as in

in the *Hatchet* to Cleave, in the *Knife* to Cut; yet can they not produce the said Effects, except they be actuated and applied by another *Cause*. And therefore are called *Passive*, because they receive their *acting Power* from the *Principal Cause*.

XIX. *An Universal Cause.* The *Water* that springs up into divers Water-Works in the Gardens of Princes, and which moves variety of Machins, is the *Universal Cause* of their Motion, because it is indifferently forced up into them all: But the Artificial disposition and figure of the Pipes is the *Particular Cause*, which determines the *Universal*, and restrains it to some particular effect.

XX. *A Natural Cause.* Bodily Things, when they act, are said to be *Natural Causes*, because they produce an Effect from a Natural Propensity or Necessity, without any fore-knowing Knowledge; as the *Sun*, *Fire*, and the like: But *Man* is the *Intellectual Cause* of those things which he effects by his Understanding and Will.

XXI. *A Voluntary Cause.* A Man that *Walketh* is a *Free Cause*, because he acts spontaneously, and not by force: But a *Fire* burning Wood is a *Necessary Cause*; because where those things are present which are required to its action, as *dry Wood*, application of them to the *Fire*, and *Ventilation* or *Blowing*, it cannot but *burn* them, neither can it exert any other Action instead of it.

XXII. *A Proper Cause, and without which.* The *Sun*, whilst it enlightens a Chamber, is the *Proper Cause* of the *Light* that is in it: But the opening of a *Window*, or taking down of the *Shutters*, is only a Cause *sine qua non*, or without which such an Effect would not follow; which Cause is also called the *Condition*, without which a Thing cannot be.

XXIII. *A Physical and Moral Cause.* A *Fire* that burns Houses, is the *Physical Cause* of that Burning or Consuming, because the *Fire* properly and of its own Nature burns: But a Man who sets *Houses on Fire*, or that exhorts or commands others to do so, is only a *Moral Cause* of this Burning; because he hath only Morally contributed to that effect, *viz.* by Exhorting or Commanding. Thus the *Serpent*, or the *Devil*, was the *Moral Cause* of the Fall of our First Parents.

XXIV. *An Exemplary Cause.* The Form which a Man proposeth to himself in going about to make a Work, is called the *Exemplary Cause*; as the Form which an Architect conceives of a *House* he is about to build; and generally whatsoever can be a Cause of an *Objective Entity*, or of forming any other Image. So he who is the Object of the Eyes or Mind of the *Painter*, is the *Exemplary Cause* of his own Effigies or Likeness.

XXV. *What the Final Cause is.* The *Final Cause*, is the *End* for which any thing is; as when a Man applies himself to his Studies, in order to the attaining of *Learning*: And therefore the *End* is commonly defined, the *Cause* for whose sake any thing is.

XXVI. *A Primary End.* An *End* is twofold, either *Primary*, which is principally intended; as the *End* of a Knife is to *Cut*; of a *Garment*, to cover the *Body*, and to shield it from the Injuries of the *Weather*.

XXVII. *A Secundary End.* A less Principal or *Secundary End* is, which moves one only in a less degree, and is only considered as something Accessory. Thus the *Secundary End* of a Garment is to adorn the Body.

XXVIII. *The End for whose sake.* That which a Man intends to do, or to obtain, is called the *End for whose sake*: So *Learning* is the End of Studies, *Health* the End of the Physician's Art, as being that which it intends to procure.

XXIX. *The End for whom, Adequate and Partial.* He for whom any thing is desired, is called the *End for whom*: So Man is the *End for whom* of Medicine; because it designs to procure *Health* to him. To form ones *Reason* aright, or to direct the *Understanding* into the knowledge of all things whatsoever, is the *Adequate End* of *Logick*: But to direct the *Understanding* in Natural things, or in the exercise of Vertuous Actions, is the *Inadequate* or *Partial End* of *Logick*.

XXX. *The Number of Causes.* Whence we may gather, that the *Material Cause* is that out of which Things are made; the *Formal*, by which; the *Efficient*, from which; the *Exemplary*, according to which; and the *Final*, for which things are made.

XXXI. *The Causatum, or Thing Caused is fivefold.* Whence it follows, that the *Effect* or *Thing caused*, which depends on the *Cause*, and by virtue whereof it is, is Fivefold; *viz.* an *Effect*, which proceeds from the *Efficient Cause*: The *Thing designed*, or the *Means* ordained to the *End*: The *Thing materiated*, or which consists of the *Matter*, and is made of it: The *Thing formed*, or constituted by the *Form*. To these you may add the *Thing exemplated*, in respect of the *Exemplar* according to which it is made.

XXXII. *What a Subject is.* That is called a *Subject* to which something is adjoyned, or to which something accrues besides its Essence: So *Cloaths* are put on the *Body*; the *Soul* of Man is joyned to his *Body*; *Writing* is applied to *Paper*.

XXXIII. *The difference twixt a Subject of Inherence and Adherence.* A Subject of *Inherence*, is that into which something is received: So a *Spunge* is said to be the *Matter* into which the *Water* is received: The Outside of the *Wall* is that which receives the *plaister* or *whiting* in it. A Subject of *Adherence* is, which receives another thing upon it self, or to it self, as a *Hand* that puts on a *Glove*. A Subject *Containing*, is that which comprehends any thing within it self; as a *Vessel* doth *Water*, or the *Sheath* doth the *Sword*: Because by *Subject* nothing else is understood here, than that to which something is joyned besides its Essence; or to which something supervenes after its production and constitution.

XXXIV. *A Subject is sometimes taken for an Object.* A *Subject* is sometimes taken for an *Object*; as when we say, to *subject* a thing to the Eyes of any one; that is, to propose a thing to any ones Faculties, that he may act about or in it. So the Object of *Hearing* is a *Sound*, the Object of *Seeing*, *Colour*.

XXXV. *What an Adjunct is.* We call that an *Adjunct*, which we consider to be in a thing besides it Essence, as something added, accruing or hapning to it, whether the same bring along with it some proper Reality; as *Fire* in the Pores of hot *Iron*, the *Soul* in the *Body*: Or whether it be nothing else but a Mode of Substance; as *Love* or *Science* in the Mind; *Motion*, *Figure*, *Rest*, *Situation* in a Body.

XXXVI. *Adjuncts are only attributed to their Subjects in the Concrete.* An *Accidental Adjunct* is predicated of its Subject in *Concrete*, and not *Abstractedly*. That is called a *Concrete Adjunct*, which denotes the Accidental form together with the Subject; as *White*, *Learned*, *Great*, *&c.* An *Abstract Adjunct* is that which signifies only the Accidental or Modal form; as *Whiteness*, *Learning*, *Greatness*. Wherefore an *Adjunct* is predicated of its Subject in the *Concrete*; *Snow is white*, Socrates *is Learned*, *Great*: But by no means in the *Abstract*; as *Socrates is Whiteness*, *Learning*, *Greatness*.

To these things thus at large explained, we will subjoyn this Rule.

The Sixth Rule of Truth.

XXXVII. The Sixth Rule of Truth.

The Idea or Perception of every thing is by so much the more clear and perfect, by how much the more Parts, Causes and Adjuncts of the thing it doth represent.

For from the *Parts* we have a view of the *Whole*; from the *Causes*, what is contained in the *Effects*; from the *Adjuncts*, as so many Complements and Ornaments, we perceive the *Nature* of the Subject, and its *Qualifications*, especially from its proper inborn Qualities.

CHAP. X.

Concerning the Distinctions, whence the Nature and Difference of Idea's *is deduced.*

I. *What is the Consent and Dissent of Things.*

FOr a more clear understanding of what follows, we will premise something concerning the *Consent* and *Dissent* of Things. Now those things seem to me to Consent, which agree in Common *Attributes* and *Logical Notions*; and those to Dissent, which do more or less disagree in the same.

The Seventh Rule of Truth.

II. The Seventh Rule of Truth.

Those Things are to be looked upon as Agreeing, which agree in some common Idea or Reason, or whereof the one is included in the Idea of the other; and they are said to disagree or to be diverse, which are the Objects of Different Idea's, and are apprehended after a diverse manner; or the one whereof is not included in the Idea of the other.

III. *Which Things agree, and which do disagree.*

For those things only do *Agree*, which have the same Genus or Species, or Parts, or Causes, or Effects, or Subjects, or Adjuncts; or Agree upon some other account: Whereas those which *Disagree* in the same, are diverse and dissentaneous. But those things do most of all Disagree, which are separated from each other by opposite Differences.

IV. *What distinction is, and how manifold.*

Wherefore *Distinction* in Common is nothing else, than the Diversity we find, between many things. Which Diversity, to speak properly, is only to be found between *Existent Beings*: For that which is not, cannot be said to be distinguish'd. *Distinction* is threefold, *Real*, *Modal*, and *Distinction of Reason*.

V. *What a Real Distinction is.*

Real Distinction is that which is found between two or more compleat Beings or Subsistances; as between the *Soul* and *Body*, which we know to be distinguish'd from each other, because we can distinctly know the one without the other: For we can have no more evident sign of *Real Distinction* than this, that we do distinctly and clearly understand the one without the other. I said in the Definition, that Distinction is a *Diversity*, and not a *Division*; because Distinction doth not take away *Union*, but *Identity* only. For tho' the *Soul* be never so closely United to the *Body*, yet it continues no less distinct from the same, than if it were actually separated from it: For it is sufficient to make a distinction, if the Things may be separated and preserved apart from each other.

VI. *The Soul and Body are Really Distinct, as Compleat Beings.*

But you'l object against the Instance of *Soul* and *Body*, that they are only *Incompleat Subsistances*, and therefore cannot be really distinguish'd? I answer, by distinguishing the Minor. I grant that the *Soul* and *Body* are *Incompleat Subsistances*, if they be referr'd to the Compound which they constitute. But if by calling them *Incompleat Subsistances*, you mean that they cannot subsist by themselves: This I deny.

VII. *What we are to understand by these Words,* A Compleat thing.

For when we say a *Compleat thing*, we understand nothing else, than a *Substance* furnished with such *Attributes* and *Forms*, as from which we gather it to be a *Substance*: For it is plain, that we do not know a *Substance* immediately, but from its *Attributes*, which because they must be in something or other, therefore we call the Subject in which they are, *Substance*. In which respect the *Soul* and *Body* are said to be *Compleat Beings*. The same may be said of all the Parts that concur to the making up of a *Whole*. Thus an *Eye*, for Example, is an *Incompleat Substance*, if it be compar'd with the *Body*, whose Part it is: But is said to be a *Compleat Entity*, when considered by it self alone; and in like manner the *Soul* and the *Body* are *Incompleat Substances* in reference to the Whole Man; but *Compleat*, when they are considered with those *Attributes* by which we know them to be *Substances*.

VIII. *What a Modal Distinction is.*

A *Modal Distinction* is that which is found between a *Mode* and its *Subject*, whose *Mode* it is: So *Figure* is distinguished from a Bodily Substance; the Act of *Imagining* or *Willing* from an Immaterial Substance, or the Soul. For those things we know to be Modally distinguish'd, where the one of them may be conceived to exist without the other, but not on the contrary: As we can easily understand a Corporeal Substance without *Motion* and *Figure*, but can by no means conceive Motion or Figure without a *Body*.

IX. *How two Modes are distinguish'd.*

There is another *Modal Distinction* between two Modes of one and the same Substance: As between the Figure and Motion of one and the same *Body*, or between a Substance and the Mode of another *Substance*: But this latter is rather to be called a *Real Distinction*, than *Modal*; forasmuch as That *Mode* may be clearly understood without the other, and hath no dependance on the *Substance*, as not affecting or modifying it.

X. *Distinction of Reason.*

A *Distinction of Reason*, is that which is found between a Substance and some one of its Essential Attributes: Thus *Quantity* doth not differ from a Bodily Substance, but only by a Distinction of *Reason*; as *Cogitation* from the Mind. The Sign of this *Distinction* is, when we cannot have a distinct *Idea* of the Thing, if we remove from it that *Attribute*, as appears in the Examples alledged. And so likewise, two *Attributes* of the same Substance are distinguish'd only by *Reason*, if they be such as that the Notion of the one cannot be clearly conceived without the other; as *Justice* and *Mercy* in GOD. And these are said to be *Formally* distinguish'd, because their Formal Idea's or Definitions are distinct or diverse.

XI. *What the Idea's are which we have of Things.*

From what hath been said, we may gather first, What the *Idea's* are which we have of Things; *viz.* that they are *Conceptions*, or rather the Things themselves conceived and understood by the *Mind*; by which Intellection things are said to be Objectively in the *Intellect*. So that we can express nothing in *Words*, if we understand what we say, but there must be an *Idea* in us of what we express by our *Words*: Tho' the *Idea* may sometimes be more clear and distinct, and at other times more obscure and confuse; because it implies a Contradiction

diction for me to know what I say, when I express any thing, and yet to have no other conception of it, besides the bare sound of the words. By the word *Idea* therefore we are to understand, not an Image represented in our Bodily Imagination, and delineated in some part of our Brain, but all that which is in our Mind, when we assert with Truth, that we do conceive a thing, after any manner whatsoever.

XII. *The Idea's we have, are not the Product of our Senses.* In the Second place we infer hence, that the *Ideas* of our *Mind*, do not proceed from our *Senses*: For, as was said before, nothing is so clear an object of our *Mind*, as our *Cogitation*, neither is any thing more distinctly known to us, than this Proposition, *I think, therefore I am*: Now we can have no certainty of this *Proposition*, except we distinctly conceive, what *Being* is, and what *Cogitation* is; and it would be in vain for any to demand any further Explication of these Words from us, since every one understands them, and cannot be further explained without some confusion. But who will say that these *Idea's* of *Being* and *Thinking* are produced by the *Senses*, and have been convey'd to the *Mind*, by the help of *Bodily things*? Wherefore *Ideas* are not to be attributed to the *Senses*, but to the *Mind*, which hath the Power of producing them, and forming them out of it self, without any outward assistance. Tho' indeed the *Mind* be often excited to the producing of them from things that strike the *Senses*: Because this is no more, than in the case of an *Architect*, who may be inclined to Build a House from the Mony which is promised him: But it would be very foolish therefore to assert, that Mony had been the Original of the House.

XIII. *Clear Idea's.* Thirdly, We may gather that *Idea's* are of two kinds, clear and confused: Because all of them have not the same Evidence, but exceed one another in clearness and distinction. Now those *Idea's* are called clear, which are evident and manifest to our *Mind*, when it gives heed to them; in the same manner as we say that Objects are clearly beheld, when being present to us, they act strongly enough to be perceived by us, and our Eyes are well disposed to behold them.

XIV. *Distinct Idea's.* Those *Idea's* are called *Distinct*, which are so precise, and diverse from all others, that they contain nothing, which doth not manifestly appear, to him that gives heed to them, as he ought. So when a Man feels some great *Pain*, that perception of *Pain*, is very clear to him, but is not always *distinct*: For commonly Men confound it, with their obscure *Judgment* concerning its *Nature*, which they suppose to be in the grieved part, and to resemble the *Sense* of *Pain*, which alone they clearly perceive. And the reason is the same concerning other *Qualities*, viz. *Sound*, *Colour*, *Smell*, *Cold*, *Heat*, all which they conceive to be in the Objects themselves, and think there is something like these Sensations in the *Senses*, or the *Idea's* we have upon their account. These *Idea's* therefore are called *Obscure*, because they represent things or *Objects*, confusedly or obscurely. Let this therefore be

The Eighth Rule of Truth.

XV. *The Eighth Rule of Truth.* *That Idea, or perception of a thing is clear and distinct, which represents the thing it self to the Mind, according to the foregoing Rules of* Truth: *And that obscure and confused, which doth more or less depart from the same.*

For seeing that that *Idea* is more clear and distinct, which involves least doubtfulness, and which represents more parts and Adjuncts of a thing to the Mind, and distinguisheth it from all other things; it must follow that that Perception is clear and distinct, which represents a thing to the Mind according to the foregoing Rules.

XVI. *The Rule explained.*

The Ninth Rule of Truth.

XVII. The Ninth Rule. *He whose Mind is furnished with most, and most perfect Idea's, is the most knowing and understanding Man.*

XVIII. *The Explication of this Rule.* For seeing that every thing is made manifest by its *Idea*, and whatever is known of it, is contain'd in its *Idea*, it is clear that the more *Idea's* we have in our Minds, the greater must be our Knowledge: And by how much the several Perfections do evidently and distinctly comprehend more particulars, by so much the more excellent and perfect must that Knowledge be.

AN APPENDIX.

Of the Imposition, Signification, Definition and use of Names.

I. *Of the Things that are handled in this Appendix.* FOr as much as the *Names* or *Words*, we use in discourse are Marks and Signs of our Conceptions, and consequently of the things themselves, we have thought fit to add something here concerning their *Imposition*, *Signification*, *Definition* and *Use*, and this by way of *Conclusion*.

II. Epicurus *was of opinion that the names of things were from* Nature. It hath been an enquiry amongst the *Philosophers* of old, whether the Names or Words we use in Speech, were from Nature, or from Custom, and Consent: Or, which is the same, whether it be natural for all Men to speak those words, by which they utter their Conceptions; or whether they were imposed on things from the free choice of Men, and invented to be put instead of our Conceptions. *Epicurus* ascribes the original of *Names* to *Nature*, and asserts them to be effects produc'd by the force thereof. So that the first Men, when they were struck by the Image, proceeding from the Object, and found several *Passions* of *Love* or *Hatred* stirr'd up in them, broke forth into some Voices, by which they designed them, no otherwise than if they had pointed at them with the Finger, or some other Bodily Gesture. And accordingly his opinion was, as *Proclus* tell us, Chap. XVII. That *Names* are as well from *Nature*, as are the operations of *Nature* that go before them, as a Vocal Sound, or the Function of Seeing; *for that the same thing that sees and hears, must also name the things it sees and hears; So that the Name Nature, is an effect or work of Nature.*

III. *Whence the variety of Names proceeds according to* Epicurus. For the variety of Names according to *Epicurus*, which is found in divers Nations, is to be ascrib'd to their different Temperaments, who being affected with different Passions, at the perceiving of things, did express one and the same thing diversly, that is, by a different Voice or Sound. Whence it came to pass that those Nations, who had no Commerce with others, still kept their own Idiom; whereas those that had more Communication with others, did take in some of their Words, which were unknown to their Forefathers.

IV. *Names were imposed from* Mens *free choice.* But whatsoever *Epicurus* may alledge to the contrary, the Names of things do not seem to proceed from Nature, but from the consent and agreement

ment of Men. As may be proved first from *Homonymy* or *Equivocation*, by which the same word is attributed to divers things; which was occasion'd by Mens joyning the same sound to different *Idea's*, so that the same Sound agrees to many *Things*, not according to the same, but different *Idea's*. As for Example, this word *Vacuum* or an *Empty space*, according to the vulgar use signifies, a *place in which nothing is contained, of that which we suppose ought to be in it*: As when we say that a Ship is empty, because it hath no lading. But according to *Philisophers*, *Vacuum* signifies a place in which no bodily thing is contained. In the second place, that Names have their original from the voluntary imposition of Men, is apparent from *Polyonymy*, and *Synonymy* which attributes divers words to one and the same thing: As *Liber*, *Codex*, both which signifie a Book; *Ensis*, *Gladius* a Sword. Thirdly, The same may be proved from the changing of Words, by which sometimes one Word, and at other times another is given to the same thing: as now *Aristocles*, afterwards *Plato*; now *Tyrtanus*, then *Euphrastus*, and afterwards *Theophrastus*. Which would not happen so, if words owed their use to *Nature*, and not to the voluntary institution of Men.

V. *Words signifie diversly amongst divers* Nations.

Moreover we find by Experience, that *Words* have their signification from the imposition and will of Men, forasmuch as the same *Word* signifies one thing in this *Nation*, and another in another *Nation*. For what is more common than for a Name or Word, which before represented nothing to your Mind, now to signifie something from the institution of Men? For tho' words must be taken from the People, who have the Power of giving Law concerning them: Yet it is certain, that there is a kind of Speech proper only to those who follow some particular Art or Calling. And tho' as *Philo Judæus* saith, Speech be proper to Man, as *Neighing* to a *Horse*, *Barking* to a *Dog*, and *Lowing* to an *Ox*; yet is not the faculty of speaking Natural, as to the signification of speech, but only with respect to the sound of the *Word*. For the signification of every word doth not agree to it, by any force of Nature, but wholly depends on the free will of Men.

VI. *Names are the Notes or Marks of our* Conceptions.

WORDS therefore being instituted by Men, are the *Notes*, and Signs of our *Conceptions*, and therefore of the things themselves; whether they signifie our conceptions, or the things themselves. That they signifie the inward conceptions of our Mind, appears hence, that whenever we please, we can discover our Secrets, by words to others, they being the Interpreters of our Mind, which represents the image of our Thoughts. *The word that sounds without*, saith S. *Austin* 15 *de Trin.* Cap. XI. *is a sign of the word, that lies hid within.* For otherwise, except *Words* did intimate our *Conceptions*, there would be no such thing as a Lye, which consists in this, that the Mind of a Man doth disagree with the words he utters; or when we have other conceptions in our Mind, than our words import.

VII. *Names do also signifie the things themselves.*

And that *Names* do also signifie the things themselves, we can prove by experience; for because we cannot carry all things with us, we make use of words, for signs whereby to signifie absent things. For it is apparent, when any one calls for some particular Person, as for Example, *Socrates*, that the Name by which he calls him forth signifies the thing which *Socrates* is; and when he commands him to come to him, to return answer, that the Thing is meant and not the Words. Hence the Scripture tells us, that GOD set all living Creatures before *Adam*, that he might give Names to them, conform to the Things themselves. So that it appears that Mankind makes use of Words to manifest their Conceptions, and the Things themselves.

VIII. *To avoid the confusion of Perceptions, we ought to define our Words.*

But because when Words are wrongly understood by us, it occasions great *Confusion* in our *Idea's*, and also in our *Discourse*, therefore we are used to define what we mean by our *Words*, and to declare what we would have to be understood by them. For it often happens, that one Word, signifies many Things, by which means, the Mind may be easily confounded, by applying it sometime to the one, and sometime to the other *Idea*. For example, The antient *Philosophers* perceiving that there was something in Man, that was the cause of *Nutrition* and *Augmentation*, called it the *Soul*, which *Idea* they afterwards attributed to *Animals* and *Plants*, as finding the same Faculty in them. And discovering also in Man a *Principle* of *Cogitation*, they gave to it likewise the Name of *Soul*. And so from this Sameness of the *Name*, they took occasion to confound the *Principle* of *Cogitation* with that of *Nutrition*, and *Growth*, and took Things wholly different to be one and the same: Which confusion can no otherwise be avoided, than by considering the word *Soul*, only as a Sound, devoid of any meaning, and afterwards bestowing it upon that Thing alone which Thinketh, Saying, *I call that the* Soul, *which is the* Principle *of* Thinking *in us*.

IX. *What the Definition of a Name is.*

And this is that which commonly is called the *Definition* of a *Name*, and is very familiar with *Geometricians*, by whom it is rightly made to be a kind of *Principle*. For it is in the Power of Men, to denote a certain *Idea* by certain Names or Words, and to apply them to what they have a mind. This being the difference between the *Definition* of a Name, and the *Definition* of a Thing, that it is not in the power of the Will of Man, to make the *Idea* contain what they please. For they must needs fall into Error, who going about to define Things, attribute any thing to their *Idea's*, which they do not contain. As for example, If we deprive the name *Parallelogram* of its signification, and no longer consider it, as a Figure including Four sides, but consider it only as a naked Sound, or will have it to signifie a Triangle or Figure consisting of Three sides, we may do so, if we please, neither shall we thereby make ourselves lyable to Error, as long as we make use of the word *Parallelogram* only to signifie a Figure contained within Three lines. And therefore we may say; *A* Parallelogram *hath its Angles, equal to two Right ones*, and *that the greater Angle in a* Parallelogram, *is subtended by the greater side, &c.* But if retaining the signification of the Word, and its ordinary *Idea*, which represents to us a Figure, whose opposite sides are *Parallel*, we should still assert that a *Parallelogram* is a Figure consisting of Three sides, we should fall into Error; for then we should not define a Name, but the Thing; seeing it is a contradiction, that a Figure consisting of Three lines should have its sides *Parallel*.

From

X. *How the Definition of a Name, is distinguish'd from the Definition of a Thing.*

From hence it follows. First, That the *Definition* of *Names* cannot be called in question, because they depend on the will and choice of Man. For it cannot be denied, but that he who defines a *Name*, may give such a signification to the sound of the Word, as best pleaseth him, and maintain that signification, which he puts upon it. But this cannot be in the *Definition* of *Things*, which frequently are controverted, for as much as they may be false, and represent the thing otherwise, than indeed it is.

XI. *The Definitions of things may be doubtful.*

In the second place it follows, that since the *Definitions* of *Names* cannot be questioned, they are therefore to be lookt upon as *Principles*; which cannot by any means belong to the *Definitions* of *Things*, they being *Propositions*, which can be denied by those who find any obscurity in them, and therefore stand in need to be proved, as other *Propositions*; neither are they to be taken for granted, except they be self-evident, and partake of the clearness of *Axioms*.

XII. *Whence Errors do arise in the common* Philosophy.

Wherefore they who are taught in the *Aristotelean Philosophy*, do doubly mistake, First, By confounding the *Definition* of a *Thing*, with the *Definition* of a *Name*, and attributing to the former, what only belongs to the latter; for after that they have alledg'd several *Definitions*, not of *Names*, but of *Things*, which are altogether false, and neither express the *Essence* of *Things*, nor the *Idea's* which we Naturally frame from them; they will needs have us to consider these *Definitions*, as so many *Principles*, or *Perspicuous Notions*, which no Man is able to gainsay; insomuch that if any one refuse to admit them for *Principles*, they are incensed, and do not think such a Person fit to be disputed with.

XIII. *The necessity of Defining Names.*

Secondly, The common *Philosophers* are mistaken, in that they seldom or never have recourse to the *Definition* of *Names*, to rid them of all obscurity, and to addict them to certain and clear *Idea's*, but leave them in their confusion and obscurity. Hence it is that the greater part of their *Disputations* are no better than Contests about Words; which would be easily removed, if those Words that involve any obscurity were defined, and whatsoever makes their meaning doubtful and uncertain were removed. This will appear more fully by an Example: *Philosophers* suppose that nothing is more evident in Nature than that *Fire* is *Hot*; but except it be first cleared what we are to understand by *Heat*, we shall never know, how or in what regard *Fire* is said to be *Hot*. By *Heat*, therefore they do understand either a certain power, wherewith the *Fire* is endowed, to produce in us the sensation of *Heat*, and in this case they truly apprehend the thing as it is: Or else by *Heat*, they apprehend a certain Quality, like to the sensation they perceive, wherein they are mistaken, since that is obscure, neither can it any way be made out how *Fire* is *Hot*, after this manner. For tho' it be clear that the cause of that *Motion* which we experience in our *Bodies*, be in the *Fire*, yet have not we the least ground of evidence, that the *Fire* contains any thing like that which we feel, when we stand near the *Fire*.

XIV. *It is not necessary to define all Names or Words.*

But tho' the *Definition of Names* contributs much towards the clear understanding of *Things*; yet it is not necessary to explain all *Names* by *Definitions*, because that would be often superfluous, and indeed is utterly impossible. For it is certain that Men have many *Idea's* that are so distinct, that those who understand the same Language, as soon as they hear the *Names* of *Things*, they immediately form the same *Idea's*. So they who hear those Names *Entity* or *Being*, *Cogitation*, *Existence*, *Certainty*, *Equality*, and such like, do immediatly apprehend the *Things* that answer to them in their *Minds*; and therefore it is superfluous to explain them by *Logical Definitions*, as being most simple *Things*, and such as are known of themselves. I said also that it was impossible to define all *Names*, forasmuch as to the explaining of any Word, we must make use of other Words, to determin the *Idea's*, to which the Words are addicted, and those Words again stand in need of other Words to explain them, so that it would be necessary to run into infinite. For this Reason we must keep to Primitive Words, and not easily change those which Use hath made to pass current amongst Men.

XV. *In the use of words we are never to recede from the common received Sense and meaning of them.*

They are much in the wrong, who when any Word is to be defined, do not consider what Sense Men commonly attribute to it, and that as far as may be, they are never to recede from it. So he that would put the Name of *Parallelogram* upon a Triangle, would be accounted a Mad-man for his Pains, for contradicting the *Etymology* of the Word, and running Counter to common use and custom. In which regard the *Chymists* are greatly to be blamed, who without the least profit thence ensuing, have changed the Names of Things, and assigned others to them, which have no true Affinity at all with those *Idea's* to which they affix them. Thus by the Name of *Sulphur* (*Brimstone*) they do not understand that Thing, which the Vulgar know and call by that Name, but *a liquid, odorous, oleous* and *Inflammable Substance*, which is the Glue that joyns the Parts of dry Things together: Neither do they by the word *Mercury*, understand *Quicksilver*, but a certain most subtil and clear Liquor, of an *Acid* or Sourish Taste, which readily Penetrates every where, and easily vanisheth away. And by the name of *Water* they understand another far more copious Liquor, which dissolves *Salt*, which cannot be dissolved by *Sulphur* or *Mercury*. Hence we infer

The last Rule of *Truth*.

XVI. The Tenth Rule of Truth.

The Names of Things which we use in Philosophizing, *must be clear and determinate as to their Signification; not Obscure or Ambiguous.*

For seeing that all the Things which we do heedfully Interpret, are delivered by us, in *External Expressions*, the highest excellency whereof is *Perspicuity*, it is necessary that we make use of fit and usual Words for the expressing of Things, and take care to give distinct Names to distinct Things.

The Second Part of Logick.

Concerning the Right Judgment of the Mind; or Proposition.

CHAP. XI.

Of Judgment, *Absolute and Compared.*

I. *What Judgment is, and that Affirmation and Negation belong to it.*

HAving thus informed our selves what *Idea's* are, and how they are distinguish'd from each other, the Order we have set our selves in the beginning of this Treatise of LOGICK, requires that we now speak of their *Composition*, whence JUDGMENT, or the Second Operation of the *Mind*, as others call it, doth proceed. And herein consists the whole Sum of our *Knowledge*; because when our *Mind* hath once past a firm and stable *Judgment* of any thing, it thinks it self arrived to the very Top of *Science*. To *Judge* therefore, is nothing else, than to assent to those Things, of which we have clear and distinct Idea's; or to deny our assent to those things whilst the Idea's that represent them are obscure, and are perceived to be so. And therefore *Judgment* is a kind of *Composition*, by which the *Mind* joyns one *Idea* with another by *Affirmation*, or separates it from another by *Negation*: As when from the Perception of the *Sun* and *Light*, he assents that the *Sun is Lucid*; or from the Perception of the *Moon* and *Cheese*, denies *the Moon to be Cheese*.

II. *To Judgment* assent *or* dissent *is required.*

For it is not sufficient to *Judgment*, to know two *Idea's* jointly; but it is necessary, that the one be conceived to be in the other, and that assent be given to *Truth* as soon as it appears: For an *Affirmation* and *Negation* appertain to the Essence of *Judgment*; neither can there be any Judgment without *Assent* or *Dissent*. Wherefore as long as a Man sticks in doubtful Enunciations, to which the *Will* doth not yet yield its *assent*, and being Uncertain, enquires concerning the *Truth* of them, he cannot be said to *Judge*, till after a full determination of his *Mind* he affirms the thing to be, or denies it to be such as he perceives it.

III. *To the right forming of Judgment, it is first required, that the* Understanding *precede.*

To the right Forming of *Judgment*, it is required, First, That the *Understanding* do precede, and that the things be known, before that we affirm or deny any thing concerning them; since we cannot attribute ought to another thing, except we have first perceived them both. Wherefore in every *Categorical* or *Simple Proposition*, it behoves us to have a distinct Perception of the Terms, *viz.* the *Subject* and the *Attribute*, before we assent to the Conjunction of them; in every *Hypothetical*, of the *Connexion* of the *Antecedent* and *Consequent*; in a *Modal*, of the *Mode* and the *Thing said*; in a *Disjunctive*, of the *Repugnance* between the *Antecedent* and the *Consequent*; in a *Copulative*, of their *Simulty* or Existing at one and the same time. And the same Caution is to be used in refusing our *Assent* to any Proposition; seeing that Men for want of this Observance fall into great Errors, and judge preposterously of things. How many are there that judge the *Earth to be plain* or *level*; that the *Moon* has the *Figure of a Dish* or *Platter*; that the *Stars* are very *Little things*, and that the *Sun* is *much less than the Earth*; because they never had a true Perception of any of these things, but trusting to their Infant Prejudices, believe nothing to be True, but what agrees with the report of their Senses.

IV. *Secondly, we must examine all things anew.*

Wherefore it is requisite in the next place, for the avoiding of all Mistakes in *Judging*, to take a firm Resolution, not to admit any of those things for *Truth*, which formerly we believed such, before we have called them to a fresh and accurate Account, according to the foresaid *Rules* or *Precepts* of clear and distinct *Perception*; and that we suspend our *Judgment*, till we be certain of their Truth. For he who withholds his *Assent* is thereby secured from Error; and he who *assents* to what he hath well understood, is so far from being Mistaken, that he embraces and enjoys *Truth*.

V. *Thirdly, In passing our Judgment, we are to distinguish between Objects and Occasions.*

In the Third place, To avoid our mistake in *Judging*, we must distinguish between the Things and Occasions in which we are to pass our Judgment: For either we are conversant about the Search of *Truth*, or about the things that belong to *Life*, and which are considered with relation to Practice. If we consider things under the first respect, we must suspend our *Judgment*, when they are not fully known by us, that is, when any obscurity or confusion appears in the things we have under Examination. If we consider them the Second way, we need not make use of so great Precaution, especially when the necessity or opportunity of Business doth not allow us sufficient time for an exact Disquisition; for otherwise we should often let slip an Occasion, before we could resolve our Doubts about the matter. Wherefore in cases where delays are prejudicial, it is best to examine the thing only so far as Time permits, and to embrace what appears for that time cleerest and best to us. And having once past our Choice, we are no longer to consider it as Doubtful, in reference to Practice; but as a thing most evident and certain, as if we had been assured of it by a clear and manifest Demonstration.

VI. *What Compar'd, or Comparative Judgment is.*

Compared, or *Relative Judgment*, is between more things, which we refer to another Third thing; in which, if they agree, they are called *the Same*; but if they disagree, *Diverse*. For *Comparison* is not the simple Consideration of one thing, to which we Assent or Dissent; but the Comparing of one thing with another in *Quantity* or *Quality*: In *Quantity*, when we enquire not only of the Dimension, but of the Value, Virtue, or Perfection of a thing; for from hence comes the *Equality* and *Inequality*, *Greater* and *Lesser*. For things that are compared together in *Quantity*, are such as have either the same *Quantity* one as the other, or a greater or lesser.

VII. *What things are even or Equal.*

Things that agree in the same *Quantity*, are called *Even* or *Equal*, because they are compared with respect to something, which is found in the things compared in an Equal Proportion. As at the *Equinoxes*, the *Night is equal to the Day*: Hector *is equal to* Achilles *in Bodily Valour*. For-asmuch as by the Name of *Quantity*, is not precisely to be understood *Mathematical Magnitude*, but any Equality or Inequality, whether it be measurable, or not.

VIII. *What Uneven, or Unequal. What Greater.*

Things that differ in *Quantity*, are called *Uneven*, or *Unequal*; and such are either Greater or Lesser. *Things Greater*, are such as exceed others in Quantity, or which by their Quantity, exceed the Quantity of those things wherewith they are compared.

Those

G. Freeman Inv.

I. Kip Sculp.

To the R.t Worshipfull Knight, their Majesties Son and Heyre of Henry near Rippon in Yorkshire Daughter and Coheyre of Blencow in Cum=berland Knight.

S.r William Thomson Sergeant at Law, only Thomson of Hollin Hall Gent, by Elizabeth of S.r Henry Blencow, Knight.

This Plate is humbly Dedicated, by Richard Blome.

IX. *What Lesser.* Those things are *Lesser*, which in Quantity are exceeded by others: For the Lesser is made use of to set forth the Greater *Excellence*, *Dignity*, *Number*, or *Usefulness* of the other. Thus *Plato* is *said to be a more Excellent Philosopher than* Socrates: *A Dog swifter than a Wolf.* A Comparison in *Quality* is, when the *Similitude*, that is, the Proportion; or *Dissimilitude*, that is, the *Disproportion* of things is consider'd. Where by the Name of *Quality*, we are not to understand a *Physical* or *Natural*, but a *Logical Quality*; such as is *Affection*, *Nature*, *Faculty*, *Action*, *Passion*, *&c.*

X. *What things are Like.* Hence those Things are called *Like*, which agree in *Quality*; or which being compared together, are found to have some *like* Affection or Faculty. As when we compare the *Sun* and the *fix'd Stars*, with respect to *Light* which is found in them both, we say they are like one another. For things compared are not alike in all things, but differ also in many *Specialties*. But when we compare those parts or respects wherein they agree, from one Like we rightly conclude the other, because the *Effects* and *Adjuncts* of like Causes and Subjects are alike, and so on the contrary.

XI. *What Unlike.* Those things are *unlike* whose *Quality* is diverse; or those are diverse *Comparates*, which differ in Qualities, Actions, and Passions. So, *A Wise man is unlike to the Moon; A Constant man is unlike to a Reed shaken with the Wind.* Hence from things that are Unlike, Unlike things are concluded; because the *Effects* of Unlike Causes are unlike, as are the *Adjuncts* of unlike Subjects, and on the contrary. Wherefore because a *Reed* is easily driven this way and that way by the Wind; and S. *John* is not so easily shaken, therefore in this regard, S. *John* and a *Reed* are unlike. Here we are to take notice, that the Unlikeness is to be restrained within the bounds of that *Quality*, wherein the Comparison is made.

CHAP. XII.

What a Proposition is, and how manifold.

I. *What things make up a Proposition.* A *Proposition*, or *Enunciation*, according to *Aristotle*, is an *Oration* or *Speech*, which *affirms* or *denies*; or an *Oration*, that signifies either *true* or *false*. From which Definition it clearly appears, that to every Proposition two *Forms* at least are required; the One, of which something is affirmed or denied, which Term is called *Subject*; the Other, which is said or denied of another, which Term is called the *Attribute*: As when I say, *God is Existing*; *God* is the Subject, and *Existing* the Predicate.

II. *The word* Is, *joyns the Predicate with the Subject.* But because it is not sufficient to conceive these two Terms, except by our *Cogitation* they be joyned together, or disjoyned; the word *Is*, is the Sign of the *Mind*'s affirming, that is, of joyning these two Idea's of *God* and *Existing*, as agreeing together. But when I say, *God is not finite*, the word *Is*, joyned with the Negative Particle *Not*, imports an Action contrary to Affirmation, or denotes, that we look upon these two *Idea's* as repugnant; forasmuch as in the conception of *Finiteness* something is included, which is contrary to the Nature of *God*.

III. *A Proposition doth not always stand in need of an Attribute, Subject, and something to joyn them both.* Yet sometimes we express Propositions after another manner: As when we say, *Charles walketh*; *Injustice thrives amongst men*; because under these words, as well the Connecting word *Is*, as the Predicate are contained: And therefore these Propositions are the same as if one should say, *Charles is walking*; *Injustice is thriving amongst men*: Yea, it is customary with *Logicians*, as often as the word *Is*, is used without any Predicate following it, to understand the Predicate to be comprehended under it: For this Proposition, *Man is*, is resolvable into this other, *Man is existing*. It matters not therefore whether a Proposition consist of Three words, as *Charles is walking*, or of Two, as *Charles walketh*, or One word only, as *Ambulo*, *I walk*, the Latin word including all the Parts of a Proposition in it.

IV. *A Proposition is either Affirmative or Negative.* From this Explication of a *Proposition* it follows, that all *Propositions* are either Affirmative or Negative: For since the Judgment of our Mind is twofold, *viz. Assent* and *Dissent*, Propositions which are the Interpreters of it, must likewise be divided into *Affirmative* and *Negative*. Which indeed is the first and chiefest Division of them, as being taken from the *Copula* or Connecting word it self, or from that Action of the *Mind*, which either joyns the Attribute with the Subject, or separates it from it.

Wherefore concerning the Judgment of an *Affirmative* and *Negative Proposition*, let this be

The First Rule.

V. *The first Rule.* *That is an Affirmative Proposition in which the* Subject *and* Attribute *are joyned, or do agree; and Negative, in which they are disjoyned, or disagree.*

VI. *Explication of the Rule.* For a Thing is then affirmed to be what it is, when the *Predicate* or *Attribute* agrees with the Subject, or when it is one and the same thing with it: As when we say, *Man is an Animal*. But a thing is pronounced not to be, what it is not, when the Attribute differs from the Subject, and agrees not with it: As when we say, *Man is not a Beast*, because Man is declared not to be such, as indeed he is not. This Division of a *Proposition* is according to *Quality*; because when any one asks, of what kind the Proposition is, it is answered, *Affirmative* or *Negative*.

VII. *In an Affirmative Proposition the Attribute is restrained.* We are to observe, that in an *Affirmative Proposition* the *Attribute* is to be taken in all its Comprehension, but not in all its Latitude. As when I say, *Every Circle is a Figure*; whatsoever is contained in the Idea or Essence of a *Figure*, the same is affirmed of a *Circle*; but yet the word *Figure* is not taken in its whole Latitude, for it is of much larger extent than that of *Circle*; and therefore this Proposition cannot be simply converted in saying, *Every Figure is a Circle*. Wherefore in this Proposition the *Attribute* is restrained by the *Subject*, and reacheth no farther than the Subject doth.

VIII. *But not in a Negative.* But the case is different in a *Negative Proposition*; as, *No Circle is a Square*: For here the *Attribute* is taken in its whole Latitude; so as that we may say as well, that *No Square is a Circle*, and all *Squares* must be denied of a *Circle*. But the Attribute is not taken according to the whole Comprehension of its Idea, as if all the Attributes of a *Square*, were to be denied of a *Circle*: For a *Circle* and *Square* agree in the Idea or Notion of *Figure*.

There

IX. *There are Propositions Universal, Particular and Singular.*

There is another *Distinction* between *Propositions*, which ariseth from the Subjects, that go before the *Copular* according to which they are called, *Universal*, *Particular*, or *Singular*. An *Universal Proposition* is that to whose Subject a Note of *Universality* is annexed; such as *Every* or *All*, *None*: As, *Every Man has a Soul*; because Man is a common Term, which is taken in its whole *Latitude*. But when a common Term is only taken in an undeterminate part of its *Extension*, with these Notes; *Some*, *Some Body*, *&c.* then it constitutes a *Particular Proposition*, whether it Affirm, as *Some Lovers are miserable*; or deny as, *Some Courtiers are unjust*. But if the Subject of the Proposition be Particular, it makes a *Singular Proposition*, as *Charles* I. *now Reigneth in England*. And this *Distribution* of a *Proposition*, into *Universal*, *Particular* and *Singular*, is said to be made with respect to *Quantity*, because when any one asks *Quanta* (of what extent) the *Proposition* is, we fitly answer, that it is *Universal*, *Particular* or *Singular*.

The Second Rule.

Concerning the Judgment of an Universal, Particular and Singular Proposition.

X. The Second Rule.

The value of these Propositions is to be Estimated, from the Extension and Limitation of the Subject and Attribute.

XI. *Universality is two-fold*, Metaphysical *and* Moral.

That we may the more exactly distinguish *Universal Propositions* from Particular, we are to take notice of a two-fold *Universality*, the one *Metaphysical*, the other *Moral*. *Metaphysical Universality*, is when a thing is taken according to its whole Extension, without any Exception: As, *Every Body is Extended*: For this admits no Exception. *Moral Universality* is that which hath Exception; because in Moral Things, it is only minded whether things be so for the most part, as they are declared to be. As if one should say, *All Singers have this fault, that they never will be entreated to Sing, but when not entreated, they can never leave Singing:* Because it is sufficient if it commonly be so. For seeing that such *Propositions* as these, are not so general but that they admit of Exception, nothing can be rigorously infer'd from them; since it may be false of this or the other particular *Singer*, that he will never be Entreated to *Sing*, and never cease *Singing* when not Entreated.

XII. *Propositions of the Singulars comprehended under one Genus.*

There are other *Propositions* that are *Universal de Generibus Singulorum*, but not *de Singulis Generum*, that is, of all the Species contained under one *Genus*; but not of all the Particulars of the same kind: As, when it is said that *all living Creatures were saved in the* Ark *of* Noah, which is not so to be understood, as if all, of all the Species of *Animals* had been shut up in the *Ark*, in the time of the *Deluge*; but only that some of all kinds were there saved.

XIII. *Propositions Indefinite.*

Besides the *Universal*, *Particular* and *Singular Propositions*, there are those which are called *Indefinite*, which tho' they have an *Universal Subject*; Yet the same is taken neither Universally nor Particularly, but Indeterminately: As, *Man is a Living Creature*. *A Triangle has Three Angles equal to Two Right ones*. Because no Universal Note as *Every*, *None*, or Particular, as *Some*, *Some one*, is put before *Man* and *Triangle*.

XIV. *Of Propositions, some are Simple and others Compound.*

A *Proposition* in general is divided into *Simple* and *Compound*. That is a *Simple Proposition*, which consists only of one Subject and Predicate: As, *Man is a Living Creature*. *A Loadstone draws Iron*. *Compound Propositions* are such as consist of more Subjects and Predicats: As, Peter *and* John, *went up at the ninth Hour of Prayer*. Where this *Attribute went up*, is not affirmed of one Subject, but of more than one, *viz.* *Peter* and *John*. And such *Propositions* as these are Equivalent to two or more *Propositions*; for if this *Proposition* were to be explained, we must do it by these two *Propositions*, Peter *went up*, John *went up*.

XV. *Words Adjective make a Complex or Compound Term.*

Words Adjective, or *Connotative*, make a *Complex Term*, whether they be put alone, or joyn'd with *Substantives*. For the Word *Wise*, doth confusedly signifie the thing in which *Wisdom* is; but denotes *Wisdom* distinctly. And when I say, a *Wise Man*, in these two Words a kind of *Proposition* is contained: For it comes to the same thing whether I say, a *Wise Man*, or a *Man that is Wise*. Wherefore every *Adjective* or *Connotative Term*, doth include a *Proposition*, which since it accedes from without, to the *Proposition* called *Principal*, it may be rightly called an *Adjunct*, or *Incident Proposition*.

The Third Rule.

Of the Judgment of a Simple and Compound Proposition.

XVI. The Third Rule.

The Simplicity or Composition of a Proposition is taken from the Combination or Disjunction of the Terms, that is, of the Subject and Predicate, whether the same be single or manifold.

XVII. *Compound Propositions are manyfold.*

Compound Propositions are of two kinds; for some are such in which the Composition is Evident; others again in which it is more hid, which the *Logicians* therefore call *Exponibiles*: Of the first sort are *Propositions*, *Copulative*, *Disjunctive*, *Conditional*, *Causal*, *Relative*, and *Discretive*.

XVIII. *Of Compound Propositions some are Copulative.*

Copulative Propositions are such as include more Subjects and Predicates, joyned by an *Affirmative* or *Negative Conjunction*. As when I say, *the Sun and Moon Illuminate the Earth*; for here I joyn *Sun* and *Moon* together, and affirm of them both, that they *Illuminate* the *Earth*. For the parts of a *Copulative Proposition*, are entire simple *Propositions*, which have another Predicate or Subject.

XIX. *Some Disjunctive.*

Disjunctive Propositions are those in which the *Disjunctive* Note *or*, *either*, *whether*, and the like is found; As, *a Man either has, or has not a Child*. *Either the* Earth *is mov'd about the* Sun, *or the* Sun *about the* Earth. The truth of which *Propositions*, depends upon the necessary Opposition of the Parts, between which no Medium can be assigned. And therefore this *Disjunctive Proposition*, *It is either a* Man, *or an* Animal, *is false*, because the Parts are not opposite to each other. As is likewise this, *It is either Peace or War*, because there may be a *Truce* or *Cessation* of *Arms*, which is a Mean between *War* and *Peace*. So that to the absolute *Truth* of *Disjunctive Propositions*, it is necessary that they have no Mean at all; but to their being Morally true it is sufficient, if commonly they have none.

XX. *Others Conditional.*

Conditional Propositions consist of two *Propositions*, joyned by the *Conditional If*, as; *If God be merciful, he will forgive Sinners*, *If that be a Triangle*,

Triangle, it hath three Angles equal to two Right ones. The First, In which the Conditional is put, is called the *Antecedent*, and the other the *Consequent*. And it is to be noted, that the *Truth* of an *Hypothetical* or *Conditional Proposition*, doth not consist in the *Truth* of the *Antecedent* or *Consequent*, but in the Union and Knitting of them both by the Conditional *If*; for a *Conditional Proposition* may be true, tho' both its Parts be false; as *If a Tree walks it hath Feet.*

XXI. *Others Causal.* *Causal Propositions*, are such as contain two *Propositions*, joyned by the *Causal Conjunctions Because, That*; As, *A Covetous Man loves no Body, because he confides only in himself. Kings are often raised to a Throne, that they may be miserable.* For to the *Truth* of such *Propositions* as these it is requisit, that the one of them be the cause of the other, and therefore both of them must be True: For what is false hath no Cause, neither can it be the Cause of another thing.

XXII. *Others Relative.* *Relative Propositions*, are known by some Note of *Comparison*; as *Where the Treasure is, there is the Heart also. A Woman is so far to be esteemed, as she is Vertuous.*

XXIII. *Others Discretive.* Lastly, *Discretive Propositions*, are such in which we frame different *Judgments*, and determine the said Difference by such Signs as these, *But, Yet*; As, *Tho' GOD be Merciful, yet he is Just. The beloved thing may be separated from a Lover, but Love not.* The *Truth* of these depends on the *Truth* of their Parts, and of the separation which is put between them. Tho' both the Parts were true, yet because there is no opposition between them, this would be a ridiculous *Proposition*: *A Covetous Man Loves Riches, and yet cannot endure that any one should be Liberal towards the Poor.* A *Discretive* is the only *Proposition* that is excluded from the *Composition* of a Syllogism.

XXIV. *Of Propositions some are Subaltern, Contrary, Subcontrary, and Contradictory.* Amongst *Propositions* that have the same *Terms*, and disposed in the same *Order*, but modified with various *Quantity* or *Quality*, are reckon'd up the *Subaltern*, *Contrary*, *Subcontrary* and *Contradictory*. *Subaltern Propositions* are an Universal, and particular of the same *Quality*: As, *Every Circle is a Figure*; *some one Circle is a Figure. Contrary*, are two *Universal Propositions* of divers *Qualities*: As, *Every Man is Rich, No Man is Rich*; which may be both false. *Subcontrary Propositions*, are two particulars of divers *Qualities*; As, *Some one Man is a Physician*; *Some one Man is no Physician. Contradictory* are such as differ in *Quantity* as well as *Quality*; As, *Every Man is a Living Creature, Some one Man is no Living Creature*: Which cannot both of them be true, nor both false.

CHAP. XIII.

Concerning the Truth and Falshood of Propositions.

I. *Truth is found in three things* 'Tis commonly said that *Truth* and *Falshood* are found in these three Things; *viz.* In the *Mind*, in *Things*, and in *Propositions*. *Truth* is in the *Mind*, as in its Subject: So things are said to be true, in the *Divine Intellect*, because they had there from Eternity, their objective and known *Being*: Which does not properly place any *Eternity* in them, but in *God*. *Things* are said to be *True*, when they have such an Essence as they ought to have, or when they comport with their *Idea*; and those false which disagree with their *Definition* or *Essence*. So GOD answers to that *Idea*, which he himself hath of a *Being*, Infinite, Immense, Eternal, &c. But the *Sun* is no true *God*, because it differs from that form of Cogitation which we have concerning *God*.

II. *Wherein the Truth and Falshood of a Proposition doth consist.* The *Truth* of a *Proposition*, consists in this, that it pronounceth a Thing to be such as it is: As when I say, *the Earth is Round*, it is a true *Proposition*, because I Affirm that of the *Earth*, which belongs to it, *viz.* a Round Figure. So likewise when I say, *A Beast is not Rational*, it is a true *Proposition*, because I remove from a Brute what does not belong to it. Wherefore *Truth* is said to be the Property of a *Proposition*, and to which it peculiarly doth belong. For since a *Proposition* is either *Affirmative* or *Negative*, that wherein the Attribute is affirmed to be in the Subject, is True, that is, conformable to the Object, if it be really in it; and False if it be not in it. And so a *Negative Proposition*, in which the Attribute is denied to be in the Subject, is True if it be not in it; but False if it be in it.

III. *Truth is either objective or Subjective, which is also called Formal.* The *Truth* which consists in the Connexion or dissent of both extreams, is called *Objective*; but *Subjective* or *Formal Truth*, is the *Judgment* or *Act* of the *Mind*, by which the extreams of a *Proposition* are joyned together; or disjoyned as far as the Judgment agrees with the thing it self.

IV. *One and the same Proposition cannot be true and false at one and the same time.* The same *Proposition* cannot be both True and False, for then Contradictories would exist together. For suppose some *Affirmative Proposition*; if it be true, the Attribute agrees with the Subject; if *False*, it doth not agree. And therefore, if we should suppose it to be *True* and *False* at once, then must it at the same time agree and not agree. Now it is a contradiction that the same thing should agree and disagree with the same thing; or that the same Attribute should be, and not be in the same Subject. It follows also, that we cannot at the same time Assent to, and Dissent from the same thing, because both those Judgments are opposite, and that the one excludes the other: Which would happen, if the same *Affirmative Proposition*, were at the same time *True* and *False*; for we should assent to it, if the Attribute did agree with the Subject; and should deny our assent, if it did not agree; which plainly implies a Contradiction.

V. *An Objection answered.* If you object, this *Copulative Proposition*, Claudius *and* Theophilus *Gaze upon the Stars*, when only one of them beholds the *Stars*, will be both *True* and *False*; seeing it is True, that the one beholds the *Stars*, and the other not. I answer, that this *Proposition* to speak absolutely is *False*, forasmuch as *Copulative Propositions* import a Sameness of Time, and their *Truth* depends on both extremes, so that if one of them doth not agree with its Attribute, it renders the *Proposition False*. As, suppose any one should say, *A Good Life and Riches are necessary to Salvation*, this Proposition would be False, because that tho' a Good Life be necessary to Salvation, yet Riches are not. But if we take this Proposition without including any Sameness of time, then it will furnish us with two *Mental Propositions*, and so it will be True, *Claudius* Gazeth on the *Stars*, and *Theophilus* does not; and on the contrary.

VI. *Propositions necessarely true, and necessarily false.* Tho' it be necessary that all Propositions be either True or False, yet are not all equally true and certain: Or which is the same, the Attributes do not agree with the Subjects in the like degree of necessity.

neceſſity. For ſome *Attributes* are after that manner in their Subjects, that their *Subjects* cannot be without them: As *Extenſion*, with reſpect to *Bodily Subſtance*; *Cogitation*, in reference to the *Soul*: And therefore this Propoſition, *A Body is an extended Subſtance*; *A Soul is a thinking Subſtance*, are called neceſſary, becauſe their Predicats and Subjects are united by an Indiſſoluble Band. Whereas other Attributes are at ſuch a diſtance from thoſe Subjects, that its impoſſible for them to agree with them, as a *Stone* with relation to *Man*; *Unevenneſs* with reſpect to the Number *Two*; and therefore theſe Propoſitions, *Man is a Stone*; *The Number Two is Uneven*, are ſaid to be neceſſarily *falſe*; becauſe there is a manifeſt Repugnance, that the Predicate *Stone* ſhould agree with *Man*, and *Unevenneſs* with the Number *Two*. Both theſe kind of Propoſitions, by reaſon of the immutable Conſent or Diſſent of their Terms, are ſaid to be of *Eternal Truth*.

The Fourth Rule.

Concerning the Judgment, or a Propoſition neceſſarily true or falſe.

VII. The Fourth Rule. *That Propoſition, whether Affirmative or Negative, is true, wherein things to be joyned, becauſe of the immediate and indiſſoluble Band of the Terms, that is, of the Subject and Predicate, are conjoyned univerſally of themſelves, and reciprocally; or are diſjoyned, becauſe of the incompoſſibility or repugnancy of their Terms. And on the other hand, That Propoſition is falſe, wherein Things to be joyned are disjoyned, and things Diſſentaneous conjoyned.*

VIII. *The Rule explained.* For ſeeing that *Objective Truth* conſiſts in the Agreement or diſagreement of both Extreams, *viz.* of the *Subject* and *Attribute*, it muſt follow that that Propoſition in which things conſentaneous are Conjoyned, becauſe of their indiſſoluble Connexion, is neceſſarily true: As, *Man is a living Creature*; becauſe Man, without a living Creature, cannot be. And, *Man is not a Beaſt*, is neceſſarily true; becauſe it is repugnant that Man ſhould partake of the Nature of a Beaſt. In like manner theſe Propoſitions, *Man is not a living Creature*, and *Man is a Beaſt*, are neceſſarily falſe; becauſe it is a contradiction that living Creature ſhould be ſeparate from Man, or that Man ſhould be a Beaſt.

The Fifth Rule.

IX. The Fifth Rule. *That Propoſition, whether Affirmative or Negative, is contingently true, wherein the Subject and Attribute do only ſometimes agree, or not agree, becauſe of their ſeparable connexion; and that falſe, in which the thing is otherwiſe expreſt than it is, whether it be propounded Affirmatively, by conjoyning things which are to be disjoyned; or Negatively by disjoyning things to be conjoyned.*

So this Propoſition, *The Air is enlightned*, or *Man runs*, is only contingently true; becauſe the *Subject* in the firſt Propoſition, *viz. Air*, may be without its Attribute, as being but ſometimes enlightned: And the *Subject* in the ſecond Propoſition, *viz. Man*, may likewiſe be without its Attribute, ſeeing it is but ſometimes that he Runs. But if any one, whilſt the Air is enlightned, ſhould ſay the Air is not enlightned, the Propoſition will be falſe; becauſe he ſeparates Light from the Air, which then agrees to it: Or if when it is dark, he ſhould ſay, The Air is Light; becauſe he joyns things that ought to be disjoyned.

X. *What Opinion, Science and Error is.* Hence it appears, what is a probable Propoſition and *Opinion*, as alſo what *Science* and *Error* is. For ſeeing that the probability of a Propoſition conſiſts in this, that it approacheth more to Evidence than Obſcurity, that *Propoſition* is to be accounted *probable* to which the Mind aſſents, becauſe of the likelyhood there is of the Attributes agreeing with the Subject, or on the contrary, of the Attributes diſagreeing with the Subject. Whereas *Science* is, when the Truth of a thing is certainly and evidently perceived by Reaſon. For ſince the certainty of a Propoſition depends of its Evidence, that Propoſition is accounted certain to which the Mind firmly adheres, and whoſe Attribute it judges doth neceſſarily agree with the Subject. And laſtly, *Error* is, when the Mind aſſents to a falſe Propoſition for a falſe Reaſon, which it apprehends to be a true one.

XI. *Contingent Propoſitions are disjunctively neceſſarily true or falſe.* There are other Propoſitions, which tho' they be neither neceſſarily true nor falſe, yet muſt needs be either true or falſe *disjunctively*; ſuch are thoſe Propoſitions whoſe Predicats do only *contingently* agree with their Subjects, and may be abſent or ſeparate from them: As, *Rich*, *Powerful*, *Married*, *&c.* with reſpect to Man. Wherefore theſe Propoſitions, Croeſus *is rich*; Caligula *is powerful*; Thomas *is a Husband*; are ſaid to be Contingent, that is, they are true in ſuch a manner, as that they may be falſe; and yet it is neceſſary for them to be either true or falſe ſeparately: Becauſe every Propoſition, in contingent matter, is either true or falſe disjunctively, that is, cannot be deny'd to be either true or falſe. It may indeed be deny'd, that ſuch a Propoſition is neceſſarily true or neceſſarily falſe; but it cannot be deny'd, but that it muſt be either neceſſarily true, or neceſſarily falſe disjunctively.

XII. *A true Contingent Propoſition, cannot be changed into a falſe one.* A true Propoſition in Contingent Matter, cannot be changed into a falſe one. Which is thus proved; becauſe if this Propoſition, for Example, *John walketh*, be true, tho' but in one inſtant of time, yet it cannot be ſaid to be falſe in that very inſtant wherein it is true: But it is true at one inſtant; therefore for that inſtant it cannot be falſe. Moreover, this Propoſition conſiders *John walking* ſuch a time, at which time wherein he is ſuppoſed to walk, it is always true; or if it ſignifie another time, in which it may be *John doth not walk*, in that caſe the Object is changed, and therefore is not the ſame, but another Propoſition.

XIII. *Objection.* If you ſay, That during the Time wherein this Propoſition, *John walks*, is pronounc'd, *John*, who before walked, may ceaſe from motion, and reſt; and thus this Propoſition, *John walks*, which before was true, will be changed into a falſe one.

XIV. *Anſwer.* To this I anſwer, That tho' at that time wherein this Propoſition, *John walks*, is pronounced, *John* may ceaſe to walk; yet the Propoſition continues true notwithſtanding, if once it was true: Becauſe it either determines the *time* wherein he walks, or that wherein he did walk, and in this reſpect the Propoſition is true; or elſe abſolutely denotes ſome difference of time in reference to which it is verified, and therefore with reſpect to that Time wherein he hath walked, is true.

The

XV. *Propositions concerning a future Contingency, have a determinate truth or falshood.*

The Difficulty is greater concerning the truth of Propositions of a future Contingent: For it is evident enough, that of opposit Propositions of the Present time, one is true and the other false: As, *Peter speaks*, and *Peter doth not speak*: But it may be doubted, whether the same truth be found in these Propositions that respect the Future time; As, *Peter will speak to Morrow*; *Peter will not speak to Morrow*. But it seems certain, that Propositions of a future Contingent, have a determinate truth or falsity: For supposing *Peter* to exist, these two Propositions, *He shall speak*, *He shall not speak*, are contradictory: Now as two Contradictories cannot be together, so it is impossible they should be both of them true, and therefore one or other must be true only; and therefore *Peter will either speak, or not speak*; if he does, the Proposition is true; if he does not speak, it is false: So that one of them is determinately true, and the other false. Again, such as are the Propositions of the Present or Past time, with respect to *Truth*, or *Falshood*, such are the Propositions of the Future: But one of these is determinately true, and the other false; *Therefore, &c.* The Major is clear: For he that pronounceth that a thing will be, and that it will not be, doth speak as true, as he who pronounceth that a thing is, and that it is not; or that a thing was, or that it was not, because it is necessary that one of them must come to pass.

XVI. *Yet is is not necessary, that it be known which of them is true.*

Neither doth it hinder, that we know not which of the Propositions be true, and which false: Because the Truth of Propositions doth not depend upon its being known, or unknown; but upon the Being, or not Being of the thing. Besides, it is certain, that *GOD* knows which of them is true, and that he can reveal the same to whomsover he pleaseth.

CHAP. XIV.

Of Division, and Definition.

I. *Transition, or Connexion of the following Matter, with what goes before.*

HAving explained the Nature of *Propositions*, and clearly and distinctly unfolded their Affections of *Affirmation* and *Negation*, *Universality* and *Particularity*, *Truth* and *Falshood*; it only now remains, that we add something concerning *Distribution* and *Definition*, which are accounted the most Scientifical, or conducive to Science of all other *Propositions*; and are nothing else, but Tokens or Instances of a clear and distinct Perception; or, if you will, they are Primary Enunciations, Axioms of solid Judgment, and Maxims worthy of all belief.

II. *What Division is.*

DIVISION therefore is the Distribution of some Whole into Parts; As, *of a Living Creature into Man and Beast*; *of Number into Even and Uneven*. Now *Division* will not a little conduce to our acquiring a clear and distinct Knowledge of Things, if so be we know how dexterously to make use of it. For seeing that almost in every Object there are many things to be considered, which because of the Difficulties wherewith they are involved, cannot be clearly apprehended by us; it is needful to resolve them into Parts, that so having by Division removed all Confusion, the Particulars may more clearly appear such as they are.

III. *Division is either Real, or Mental.*

Division is twofold, the one *Real*, the other *Mental*: The *Real* is, whereby a Whole is really and indeed divided into Parts; as *a House into the Roof, Walls, Foundation, &c.* of which it consists. A *Mental Division* is, when we divide a Whole only by the help of our *Understanding*: As when we consider in *GOD*, his *Goodness*, *Omnipotence*, *Eternity*. For it doth not always follow, that the thing which our Mind *distributes* into Parts, is compounded and *divisible*; but that only our Conception of it is compounded, and unable to understand so many *Attributes* under one and the same Notion.

IV. *The Primary Division of Genus and Species; and of an Integral, and Essential Whole.*

Division is manifold, according to the threefold kind of a *Whole* and its *Parts*. For it is either of the *Whole Genus into its inferiour Species*, or *of the Species into its Individuals*: As the *Division* of *Substance* into *Mind* and *Body*; of *Mind*, into an *Angel*, or Man's *Soul*: The other is *of an Integral Whole into its Parts*; which is properly to be called *Partition*: As the *Division* of the Body of Man into *Head*, *Teeth*, *Hands*, and *Arms*. The third and last, is the Division *of an Essential into its Essential Parts*; as the *division* of Man into *Mind* and *Body*. And these Three are called *Primary Divisions*.

V. *The Difference between the Division of a Genus into Species, and of a Whole into its Members.*

There is this difference between the two former *Divisions*: In the Division of a *Genus* into *Species*, and of a Species into *Individuals*; the thing Divided may in the Nominative Case be predicated, of the several Parts that divide it: As when *Living Creature* is divided into *Man* and *Beast*, *Living Creature* is expreset in the Nominative of Man and Beast; as Man is a Living Creature; a Beast is a Living Creature. But in the Division of an *Integral* into its Members, the thing *divided* cannot be predicated of the Dividing Members, but in an Oblique case; as when a Body is divided into *Head*, *Breast*, *Belly*, *&c.* it cannot be pronounced of the Parts, but in an Oblique: For we cannot say, *the Head is the Body*, *the Belly is the Body*, but part of the Body. And the reason of this difference is, because the whole Essence of the *Genus* is included in the *Species*, whereas the Nature of the Whole is not in every Part.

VI. *The Secondary Division of an Accident into Subjects, or contrariwise.*

The other *Divisions* are called *Secondary*; as a Division of *an Accident into the Subjects*, in which it is found. As if we should say of the things that are moved, one is the *Earth*, another is the *Moon*, *&c.* A Second, is the *division* of a Subject into its Accidents; as when a Subject is ranged or distributed according to its Accidents. As for Example, Some men are Learned, others Ignorant; some Good, and others Wicked. The Third, of *an Accident into its Accidents*; by which an Accident is divided, not by its own Differences, but by other Accidents of a different kind: As when we say of *White things*, some are hard, others soft, &c.

VII. *Conditions of a good Division. The First.*

Moreover, there are some Conditions required to the constituting of a right *Division*. First, That all and every one of its Parts be exactly enumerated, without omitting any that belong to it; so that the Dividing Members may exhaust the Divided Whole, and neither be more extended or contracted than it: As, *Even*, and *Uneven*, do comprehend the whole extent of this Term, *Number*, seeing there is no Number which is not in it self either Even, or Uneven.

VIII. *The Second.*

The Second is, That both parts of the *Division*, be as far as may be expressed in positive Terms. For the Attributes of a thing that is *distributed*, may

may be better underſtood by *Poſitive Terms*, than by Negative. I add, *as far as may be*, becauſe it ſometimes happens, that the *Poſitive Thing* wants a *Poſitive Name*, and ſo we are forced to uſe a Negative in the dividing of it: As when we divide *Living Creature* into *Rational and Irrational*: Or *Subſtance* into *Material* and *Immaterial*.

IX. *The Third.* The Third Condition is, That the Whole be diſtributed into its neareſt *Parts*; According to this Rule, it would not be well done to divide *Subſtance* into *Rational* and *Irrational*; becauſe theſe are not immediately contained under Subſtance, but under Living Creature.

The Sixth Rule.

Of the Judgment of Diſtribution.

X. The Sixth Rule. *That Diſtribution or Diviſion is the moſt perfect of all, which doth honeſtly and equally divide a Whole into its Parts; whether it be a Genus into Species, or an Integral into its dividing Members, or a Subject with reſpect to its Accidents, or an Accident into the Subject, to which by the Right of Diviſion they belong.*

XI. *Explication of the Rule.* Thus the moſt perfect *Diſtribution* of a *Genus* is, when all its Species are Enumerated: As if one ſhould ſay of *Living Creatures*, ſome *Walk*, others *Fly*, others *Swim*, others *Creep*, and others are *Plant-Animals*. An *Integral Whole* is well divided, when all the Parts that conſtitute it are inſtanc'd: As the Parts of a Man are, *Head*, *Breaſt*, *Belly*, *Arms*, *Legs*, *&c.* That is a perfect Diſtribution of a Subject, with reſpect to its *Adjuncts*, when the *Adjuncts* are reduc'd to certain *Heads*, and theſe again ſubdivided into others: As when we ſay, In *Man* there are ſome *Adjuncts* of the *Soul*, and others of the *Body*; thoſe of the *Soul*, are *Knowledge*, *Virtue*, *&c.* thoſe of the *Body* are *Health*, *Beauty*, *Tallneſs*, *Strength*, *&c.*

XII. *What a Definition is, and of what Parts it conſiſts.* DEFINITION is that which manifeſts the Nature of Things, ſhewing why they are, and how they are diſtinguiſht from others. There are two things principally that conſtitute a *Definition*, *Genus* and *Difference*. By the firſt we underſtand the agreeableneſs which the *Thing Defined* hath with others, that are of the like nature with it. By the *Difference* we are informed, how it differs from the ſame, and what Rank it keeps amongſt *Real Beings*. As for Example, when we define Man to be a *Reaſonable Living Creature*; by a *Living Creature* which is the next *Genus* of Man, we underſtand ſomething that is common to other things like unto us, *viz.* the *Beaſts*. And by *Reaſonable*, which is the Difference, we clearly perceive our Diſtinction from them; foraſmuch as no *Beaſts* are partakers of *Reaſon*. *Definition* therefore is that, *which by exhibiting the Eſſential Parts of the Thing Defined, expreſſeth its Nature*; as in the foregoing Example.

XIII. *In Definitions we muſt make uſe of the neareſt Genus.* We are to obſerve, that every *Genus* is not ſufficient to lay open the Nature of a Thing, but the Neareſt only: Partly, becauſe it contains all the *Genera* above it, ſo that by expreſſing it we include all the reſt: For he that affirms Man to be an *Animal*, doth conſequently affirm him to be *Living*, *Corporeal* and a *Subſtance*, and whatſoever elſe can be imagined higher. Partly, becauſe there is no other *Genus* can more fitly be joyned with the Specifical Difference, than the neareſt, nor which doth more correſpond with it.

XIV. *Of Definitions ſome are Eſſential, others Accidental.* Amongſt *Definitions* ſome are *Eſſential*, which properly deſerve the Name of *Definition*; and are thoſe which are explained by their Eſſential Degrees. By Eſſential Degrees, I mean *Eſſential Attributes*, which conſtitute the Nature or *Eſſence* of a thing. And theſe are only Genus and Difference, as, *Animal* and *Reaſonable* with reſpect to Man. Other *Definitions* are *Accidental* and leſs exact, which expreſs the thing by ſome *Properties* or *External Cauſes*, as when we define Man, to *be a Creature made after the likeneſs of God*. For tho' Property be an *Eſſential Attribute*, yet not in that Senſe as if it did conſtitute the Eſſence or Nature of a Thing, but becauſe it immediately follows the Nature of a thing already conſtituted: As, *Partition* and *Mobility* with relation to a *Body*. Wherefore the firſt Definition is called a *Perfect Definition*, becauſe it conſiſts only of Cauſes that do conſtitute the Eſſence, and by them doth moſt fully and perfectly lay open the Nature of the thing: Whereas the ſecond Definition is called imperfect, or a *Deſcription*, becauſe it defines and explains the Thing by other ways, than by its Cauſes.

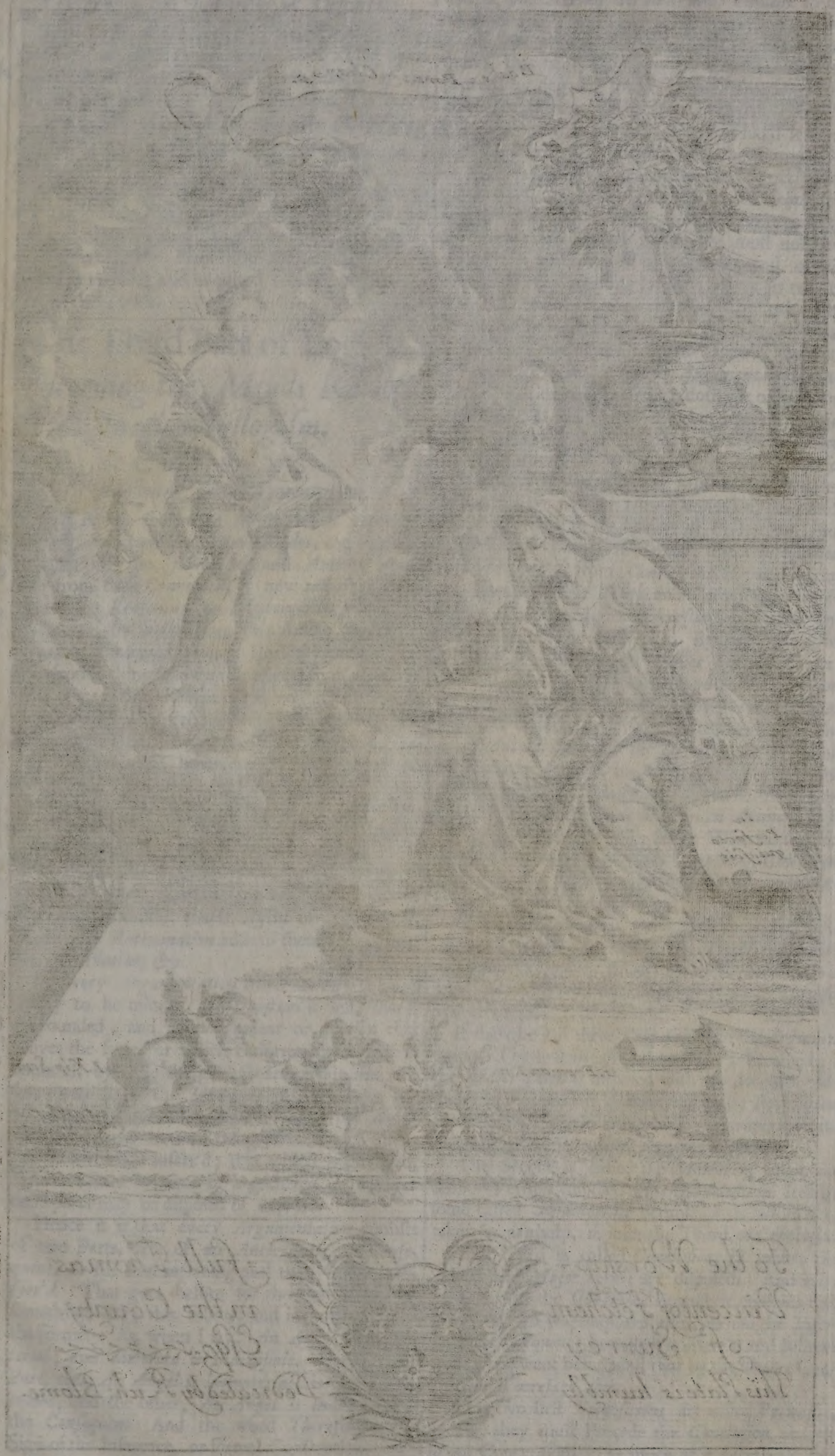
XV. *What things are required to a perfect Definition.* Yet we are not to think, that all things that are objected to the *Mind*, may be comprehended in a *Definition*; but it is required, that the Thing which is to be defined be *One*, that is of one Eſſence; for thoſe Things which involve a manyfold Nature, cannot be manifeſted by a *Genus* and Difference. The Second is, That it be *Univerſal*; for ſeeing that Definition is a Declaration of the Nature of a Thing, it is neceſſary that we diveſt it of all particular Circumſtances, that it may be viewed ſuch as it is. Thirdly, No *Univerſal Nature* but a *Species* can be exactly defined; and that becauſe nothing but a *Species* can conſiſt of a *Genus* and Difference; and therefore ſeeing that the Supream *Genus* does want them, it follows that the Things which are defined muſt be either *Species* of the loweſt Rank, or Intermediate: Which alſo will but be obſcurely defined, without their *immediate Genus* and neareſt Difference.

XVI *Rules of a right Definition. The Firſt.* There are *Rules* and *Precepts* of a right *Definition*. Firſt, That the *Definition* muſt be of the ſame extent with the Thing defined, and agree to all thoſe things which the Thing defined agrees with. As for Example, becauſe *Animal* agrees to a Man, therefore a *Corporeal Subſtance* endowed with *Life*, *Senſe* and *Motion*, which is the Definition of an *Animal*, muſt agree to Man alſo.

XVII. *The Second* Secondly, That nothing be wanting or redounding in the *Definition*, but that only thoſe Words be made uſe of, that are neceſſary for the explaining of its Nature: Wherefore this Definition of a Man, That he is a *Reaſonable*, *Mortal Animal*, is Superfluous, becauſe the Word Mortal is not needful to the Definition of a Man.

The Third. The Third, That the *Definition* conſiſt of that which is *more known*: For ſeeing that a *Definition* is declarative of the *Eſſence*, it muſt therefore employ clearer Terms; leſt we ſhould be guilty of endeavouring to explain an unknown thing, by that which is more unknown, and ſo inſtead of attaining a clear and diſtinct Perception, ſhould fall into Obſcurity and Confuſion. Wherefore the common Definition of time, that it is, *The Number or Meaſure of Motion*, cannot be good, ſeeing it is evident, or apparent, that Time doth as well Meaſure Reſt, as Motion, ſince we ſay, as well that a thing hath reſted ſo long, as that it hath been in Motion for that time.

The



To the Worship-full Thomas
Vincent of Fetcham in the County
of Surrey Esqr.
This Plate is humbly Dedicated by Rich: Blome.

The Seventh Rule.

Concerning the Judgment of Definition.

XIX. The Seventh Rule. *That Definition is the most perfect and consummate of all others, which defines the Thing by its Essential Attributes, or constituent causes of its Nature and Essence.*

As if one should define the *Soul* to be a *Cogitating Substance*, or a *Body* to *be a Substance consisting of three Dimensions.* Because *Substance* as the *Genus* doth constitute the *Soul* and *Body*; and *Cogitation* as the *Difference*, distinguisheth the *Soul* from the *Body*; As *Extension in Length, Breadth and Depth*, doth difference the *Body* from the *Soul*: Neither is there any thing else required to the understanding of them both.

The Third Part of Logick.

Concerning the Minds Ratiocination, Syllogism.

CHAP. XV.

Of Reasoning or Argumentation.

1. *What it is to Reason or Discourse* HAving spoken of *Idea's* which represent *Substance*, and their *Modes*, and concerning the *Judgment* and *Axioms* which arise from their *Connexion*, it now remains to explain what *Reasoning* or *Ratiocination* is, or that *Judgment*, by which from one *Axiom*, another is gathered or inferred. For to Reason is nothing else than from a thing known to derive the *Knowledge* of another: And *Reasoning* is nothing else, than the *Knowledge* of one thing deduc'd from the *Knowledge* of another: As when a Man infers *the Heaven to be extended*, because *all Bodies are extended.* And therefore this *Judgment* is called *Dianoetick* or Discursive, because the Mind by it runs from one thing to another, and from the *Antecedent* is lead to the *Consequent.*

II. *What it is that Argumentation superadds to Judgment.* Wherefore as *Judgment*, or the second Operation of the Mind, superadds to the first, which is *Perception*, Assertion, that is, *Assent* or *Adhesion* to Truth: So *Ratiocination* adds to them both, *Deduction, Illation, &c.*

III. *What things are to be minded in Discourse.* In every *Argumentation* there are two Things chiefly to be minded, the *Question* it self, that is propounded, and the *Argument* or *Reason* that proves the same, or which confirms that which is doubtful, by those things that are certain and evident, and from the *Question* produceth an undoubted Conclusion. Accordingly in every *Argumentation* there are two things, that which infers, and that which is inferr'd; that which is gathered, and that from whence it is gathered, howsoever these parts may be disposed or expresst.

IV. *Ratiocination contains two Parts.* Hence it is that every *Argumentation* consists of two Parts, *viz.* of an *Antecedent* and *Consequent*, or the Part *inferring* and that which is *inferr'd.* That goes before for the confirming of something else; this follows and is gathered from the former: As, when I say, *An Angel is Immaterial*; and *therefore is Indivisible.* For the first Part, *viz. An Angel is Immaterial*, is the *Antecedent*, and the other, *An Angel is Indivisible* is the *Consequent:* And the word *Therefore* is the Sign of the Inference, or formal Consecution.

V. *The Premisses must be more known than the Conclusion.* It is requisit to the Notion of an *Antecedent*, from which a certain *Conclusion* may be deduced, that it be *better known and more evident* to us; for otherwise it will not conduce to that which we would infer thence. For the Order of Science requires, that beginning from the *Easiest things*, we proceed by degrees to those which are more difficult to be known. Wherefore, to discourse readily, it is needful that we have ready at hand a Stock of many *Axioms*, Springing from the Complexion of the Things we have clearly and distinctly conceived, that may serve us instead of *Principles*, and by whose helps we may arrive to the knowledge of things more abstruse. For we must not promiscuously make use of any known and certain *Propositions* to infer any thing; but it is requisit that between them there be some Connexions by means whereof, this rather than any thing else may be gathered or inferr'd from it. Because there is a Consequence assigned to every *Argumentation*, yea a necessity of Consequence, which doth not only depend on the Order of *Knowledge*, but also on the Natural Connexion of the Things that are to be known.

VI. *Reasonings or Argumentations differs in Truth.* All *Argumentations* have not the same force; for seeing that the *Judgments* of which they are compounded, have not the same Connexion, they must needs according to the variety of *Propositions*, produce various kinds of *Reasoning*. For *Consequences* that are deduc'd from *Contingent Premisses*, cannot have so great *Truth* and Certainty as those, which are inferr'd from *Necessary Premisses*, and which cannot be otherwise. By Example, this Proposition, *Sempronia Loves her Childeren*, deduced from this Antecedent, *every Mother Loves her Childeren*, differs from this, Peter *is an Animal*, which is deduced from this Antecedent, *A Man is an Animal*: Because the certainty we have that a *Man* is an *Animal*, is *Metyphysical*; Seeing we cannot conceive a *Man* any otherwise. And therefore this Proposition, *A Man is an Animal*, is so *True*, that it can never be false: Whereas the certainty we have, that *Mothers* Love their *Childeren*, is only *Moral*, since it can happen that some *Women* may not Love their *Children.*

VII. *The Definition of an Argumentation in general.* An *Argumentation* in general, is a Speech wherein from *certain Propositions* expresly or tacitly premised, *An* other *Proposition* distinct from those premisses is necessarily inferred, by Reason of the due *Disposition* of them.

VIII. *What the Major Proposition is.* If there be just three *Propositions* in the *Argumentation*, The first is called the *Major*, because in it the *Major Term* is disposed with the *Mean* or *Medium.* And by some it is called only The *Proposition*, by way of *Excellence*, because it propounds the Foundation of the whole *Argumentation.*

IX. *What the Minor is.* The Second is called the *Minor*, in which the Minor Term is disposed with the *Medium.* It is by some called *Assumption*, because it is assum'd or taken in as a help, to infer the Third, or *Conclusion.*

X. *What the Conclusion is.* The Third is called *Conclusion*, in which the *Minor* and *Major Terms* are disposed. And is by some termed the *Question*, because it contains that whose Truth was enquired after, as also the *Inference* or *Consequence*, because it is inferr'd and follows from what went before, and that by the illative Conjunction *Therefore, &c.*

XI. *The two Propositions must go before in every Argumentation.* The two first *Propositions* are called *Premisses*, because they must Precede the *Conclusion*, at least in our Conception, in as much as it necessarily follows from them; because it is impossible, supposing

the Truth of the *Premisses*, that the *Conclusion* should not be true. Yet it is not necessary, that in every *Argumentation* the *Premisses* should be expressed, since frequently one alone is sufficient, to make the Understanding, tho' somewhat confusedly, to conceive both. For he who from this Antecedent, *Every Stone is a Body*, deduceth this Consequence, *A Diamond is a Body*, had a confused Knowledge thereof in the *Antecedent*, wherein it is implicitly contained. And he that from this Proposition, *A Body is a Substance*, infers, that *A Diamond is a Substance*, by knowing it to be a *Body*, knows it to be a *Substance*.

XII. *In every Argumentation are found three Idea's.*

Every *Argumentation* consists of three Idea's; the *Minor Extream*, or *Idea*, which is the Subject of the Question, or Conclusion, and is also called the *Minor Term*; because the Subject is of less extent than the Predicat: The *Major Extream*, or *Idea*, which is the Predicat, and which is also called the *Major Term*, because it is of larger extent than the Subject: And the *Mean*, or *Medium*, which is twice put in the Premisses, and is that which joyns both *Idea's* together; as in this Argumentation:

Every Intellectual Substance is Cogitative,
The Mind is an Intellectual Substance;
Therefore the Mind is Cogitative.

Here *Intellectual Substance* is the Middle Term; *Cogitative*, the Major Extream; and *Mind*, the Minor Extream.

XIII. *Why there are three Idea's required in every Argumentation.*

The Reason why these Three are required in every *Argumentation* is hinted by *Aristotle*, when he saith, That we meet with Three things in every *Science*, or *Demonstration*, *viz.* the *Subject*, of which the *Attribute* is demonstrated: The *Property* it self, or *Attribute*, which agrees with the *Subject*; and the *Reason*, or *Principle*, which makes out this Agreement of the *Affection* with the *Subject*. So that the *Subject*, of which the Demonstration is made, is the *Less Extream*; the *Attribute*, or *Affection*, which is prov'd, the *Greater Extream*; and the *Common Term*, wherewith the *Subject* and *Attribute* are joyned together, is the *Argument*, or *Middle Term*.

XIV. *The matter explained by an Example.*

For Example: This Question is propounded to be explained, whether *the Earth be Round*; and the thing required is, That from the Doubtful Question a certain Conclusion be deduced: The *Earth* ir the Subject or Minor Extream; *Roundness* is the Affection, or Property, to be demonstrated; and I am to find out a *Medium*, by which it may appear that the Attribute agrees with the Subject. Which may be this: That the *Shadow of the Earth*, as appears in a Lunar Eclipse, *is Round*, for the Shadow intimates the figure of *Opaque Bodies*: From which accordingly this *Syllogism* may be framed.

A Body whose Shadow is round, must it self be round also.
But the Earth is a Body, whose Shadow is round.
Therefore the Earth is round.

XV. *Sometimes more than three Idea's are found in an Argumentation.*

But notwithstanding that an Argumentation is made up of *three Propositions*, yet many more may be added to them, without any Redundance or Defect; as long as the Precepts of *Ratiocination* are but observed. For if the *Third Idea*, which we have taken to discern whether the Attribute agree with the Subject, or be removed from it, after having compared it with both the Extreams, do not give us a clear discerning, whether it agree with it or no; we may assume another *fourth Term*, to procure a further clearness; and if that be not yet sufficient, may proceed to a *fifth*, until we come to some Term, which may joyn the Attribute of the Conclusion with the Subject. As, supposing a Man should doubt whether *Courtiers be miserable*, he may consider that *Courtiers* are subject to many Passions, as *Ambition*, *Envy*, *&c.* and if he thinks this not to be sufficient, to prove them to be *miserable*, he may further examine what it is to be subject to *Ambition*, *Envy*, *&c.* which if he does, he shall find that it is continually to hanker after *Honour*, to be *grieved at the prosperity of others*, *&c.* and that such a Condition as this cannot but be obnoxious to many Miseries; whence he may form this Argumentation: *Courtiers are tormented with Ambition and Envy, and they that are so, are in continual Trouble, and they that are in continual Trouble, are miserable: Therefore Courtiers are miserable.*

XVI. *The Division of an Argumentation into Perfect and Imperfect.*

Argumentation in General, is divided into Perfect, and Imperfect. *Perfect Argumentation* is a *Syllogism*, which forasmuch as it consists of Three Propositions, duly disposed, is of a perfect Form, and most proper to persuade. An *Imperfect Argumentation* is, either an *Enthymeme*, an *Induction*, an *Example*, a *Dilemma*, or a *Sorites*, whose Form is less accurate, and not so accommodate to persuade as the Perfect. We shall first treat of a *Syllogism*, and afterwards proceed to the rest.

CHAP. XVI.

Of Simple Syllogisms; and those either Complex, or Incomplex.

I. *What Simple, and what Conjunct Syllogisms are.*

OF *SYLLOGISMS*, some are Simple, others are Conjunct. *Simple Syllogisms* are such, in which the Medium is only joyned to one Term of the Conclusion at once: *Conjunct* are those in which the Medium is at once joyned with both Extreams. Accordingly this *Syllogism*:

Every Planet is enlighted by the Sun:
Saturn *is a Planet*:
Therefore Saturn *is enlightned by the* Sun.

Is Simple, because the Medium, *viz. Planet* is separately joyned with the Term *Saturn*, which is the Subject of the Conclusion. But for the contrary Reason this *Syllogism*:

If a Covetous man serves Mammon, *he cannot obey the Law of God;*
But a Covetous man serves Mammon:
Therefore a Covetous man cannot obey the Law of God.

Is Conjunct, because a *Covetous man*, which is the Subject of the Conclusion, and *cannot obey the Law of God*, which is the Predicat, are both joyned with the Medium, *serves Mammon*, in the Major Proposition. Of this latter sort we shall speak in the next Chapter.

II. *There are two sorts of Simple Syllogisms.*

A *Simple Syllogism* is divided into two other kinds: For there are some, in which tho' the Conclusion be Complex, that is, composed of Complex Terms; yet one part only of its Subject or Predicat is taken, to be joyned with the Medium in one Proposition; and the rest, which is no more than one Term, is taken and joyned in the other Proposition: As in this *Syllogism*;

The

The Divine Law requires us, to honour Kings;
Charles *the Second is a King:*
Therefore the Divine Law requires us to honour Charles *the Second.*

There be others again, in which each whole Term of the Concluſion is joyned with the Medium; to wit, the Attribute in the Major, and the Subject in the Minor. The former are called *Complex*, the latter *Incomplex:* And of theſe two kinds of *Simple Syllogiſms*, we ſhall ſpeak under this Head.

III. *The Definition of a Simple Syllogiſm.* A *Simple Syllogiſm* therefore is a *Perfect Argumentation*, in which from two Propoſitions premiſed in the Antecedent, the Concluſion or Conſequent neceſſarily follows, in caſe the two foregoing Propoſitions have been granted. I have ſaid in the Definition, *That the Concluſion neceſſarily follows from the Premiſſes*; becauſe our aſſent to the *Premiſſes* neceſſitates the *Concluſion*, not only as to *Species*, as they call it, but as to *Exerciſe*. For the Knowing Faculty acts neceſſarily, that is, ſuppoſing all Requiſites neceſſary for Operation, cannot chuſe but operate: But when the *Major* and *Minor* are granted, there is nothing more wanting to infer the *Concluſion*; therefore the Underſtanding cannot but infer it.

IV. *The Underſtanding cannot but aſſent to a Propoſition that is clear and evident.* Neither is it any obſtacle to what hath been ſaid, that the *Underſtanding* is ſubject to the *Will:* For this is falſe, whenever the Object is evidently and diſtinctly propounded to it; becauſe in that caſe it is forced to aſſent by the Evidence of of the thing. For we often experience in our ſelves, that the *Underſtanding* cannot be reſtrained from giving its aſſent to a *Propoſition* which appears clear and manifeſt to it; tho' the *Will* may ſometimes indirectly hinder it, by diverting it, and buſying it about other Objects: But this it cannot do *directly*, by commanding it not to aſſent to the *Concluſion*; becauſe the *Underſtanding* doth not follow the command of the *Will* in things that are Evident, but only in thoſe that are obſcure and doubtful.

V. *The Form of a Syllogiſm.* The Form of a *Syllogiſm*, is the Regular diſpoſition of the three *Propoſitions*, ſo that the *Concluſion* may neceſſarily follow from the *Premiſſes*; which conſiſts in this, that the Middle Term be fitly ranked with the two Extreams, that is, with the *Major* and *Minor*; and alſo that the *Propoſitions* be orderly placed, as to *Quantity*, that is, Univerſality and Singularity; and *Quality*, that is Affirmation and Negation. The former of theſe, which is the Diſpoſition of the Terms, is called *Figure*; the latter, which is the Determination of the Propoſitions, is called the *Mode of a Syllogiſm*. So that the *Figure* reſpects the *remote Matter* of a *Syllogiſm*, *viz.* the Three Terms, the Middle Term, and both Extreams; whereas the *Modus* regards the *next Matter* of a *Syllogiſm*, *viz.* the Three Propoſitions, the Major, Minor, and Concluſion.

VI. *The three Figures of Syllogiſms.* There be three Figures of *Syllogiſms*: The Firſt is, when the Middle Term is the *Subject* in the *Major*, and the *Prædicat* in the *Minor*. The Second, when the Middle Term is the *Prædicat* in both Premiſſes. The Third is, when the Middle Term is the *Subject* in them both.

VII. *Of the Modes of Syllogiſms.* There are reckoned 21 Modes of *Syllogiſms*, which may be reduced to 14.

The *Modes* of the Firſt Figure, are *Barbara, Celarent, Darii, Ferio.*

Of the Second, *Ceſare, Cameſtres, Feſtino, Baroco.*

Of the Third; *Darapti, Felapton, Diſamis, Datiſi, Bocardo, Feriſon.*

The Modes of the *firſt Figure* are called *Direct* and *Perfect*, becauſe all manner of *Queſtions*, whether Affirmative or Negative, Univerſal or Particular, may be concluded by it. Whereas in the *Second*, Negatives only; and in the *Third*, Particulars only can be inferr'd. In all the foregoing Artificial Words there are Three Syllables, whereof the firſt ſignifies the *Major*, the ſecond the *Minor*, and the third the *Concluſion*; and the *Vowel* of each Syllable ſhews what *Quantity* and *Quality* the Propoſition muſt be of. For *A* ſignifies an Univerſal affirming; *E*, an Univerſal denying; *I*, a Particular affirming; and *O*, a Particular denying Propoſition, according to the common Diſtick.

Aſſerit A, *negat* E, *verum Generaliter ambo:*
Aſſerit I, *negat* O, *ſed Particulariter ambo.*

A *affirms*, E *denies, but Generally both:*
I *affirms*, O *denies, but Specially both.*

For the further clearing of the Figures of *Syllogiſms*, I ſhall add Examples of the Modes of each *Figure.*

The Firſt Figure.

VIII. *The firſt Figure.*

Bar- ba- ra. — *Every Body is extended,* / *Every Stone is a Body;* / *Therefore every Stone is extended.*

Ce- la- rent. — *No Mode is a Subſtance,* / *Every Figure is a Mode;* / *Therefore No Figure is a Subſtance.*

Da- ri- i. — *Every thing that is mov'd, is moved by another,* / *Some Body is mov'd;* / *Therefore ſome Body is mov'd by another.*

Fe- ri- o. — *No Spirit is Material,* / *Some Subſtance is a Spirit;* / *Therefore ſome Subſtance is not Material.*

IX. *On what Principles the firſt Figure is grounded.* The force of the firſt Figure is grounded on the *Dictum de Omni*, and *Dictum de Nullo.* The *Dictum de Omni* is this: Whatſoever is Univerſally affirmed of an Univerſal, is alſo affirmed of that which is contained under that Univerſal: As of a *Body*, it is univerſally affirmed that it is *Extended*; which muſt therefore alſo be affirmed of a *Stone*, which is contained under it. *Dictum de Nullo* is, when whatſoever is univerſally deny'd of an Univerſal, is alſo deny'd of that that which is comprehended under that Univerſal: As when every *Subſtance* is deny'd to be a *Mode*, and *Figure* is contain'd under the Notion of a *Mode*; therefore *Figure* is denied to be a *Subſtance.*

X. *The ſecond Figure.*

Ce- ſa- re. — *No Stone is a Plant,* / *Every Oak is a Plant;* / *Therefore no Oak is a Stone.*

Ca- me- ſtres. — *Every Body is diviſible,* / *No Point is diviſible;* / *Therefore no Point is a Body.*

Fe- ſti- no. — *No Impenitent perſon ſhall be ſaved,* / *Some man ſhall be ſaved;* / *Therefore ſome man is not an Impenitent perſon.*

Every

Ba- *Every Univerſal is communicable to more than one,*
ro- *Some Nature is not communicable to more than one;*
co. *Therefore ſome Nature is not Univerſal.*

XI. *The third Figure.*

The Third Figure.

Dar- *Every Body is diviſible,*
ap- *Every Body is a Subſtance;*
ti. *Therefore ſome Subſtance is diviſible.*

Fel- *No Angel is circumſcrib'd by place,*
ap- *Every Angel is Finite;*
ton. *Therefore ſomething that is finite, is not circumſcrib'd by Place.*

Di- *Some Number may be increaſed,*
ſa- *Every Number is an Affection of things;*
mis. *Therefore ſome Affection of things may be increaſed.*

Da- *Every one that ſerves God is a King,*
ti- *Some one that ſerves God is poor;*
ſi. *Therefore ſome one that is poor, is a King.*

Bo- *Some Folly is not to be blamed,*
car- *Every Folly is a defect of right Reaſon;*
do. *Therefore ſome defect of right Reaſon is not to be blamed.*

Fe- *No heavy Body tends downward of its own accord.*
ri- *Some heavy Body is Matter;*
ſon. *Therefore ſome Matter doth not tend downward of its own accord.*

XII. *Galens Fourth Figure.*

The Fourth Figure is ſaid to be *Galen's*, and is when the *Medium* is predicated in the *Major Propoſition*, and ſubjected in the *Minor*; which tho' it concludes neceſſarily, yet (as *Averrhoes* ſaith) with ſome Machination or difficulty, and beſides Expectation.

General Rules of Syllogiſms.

XIII. *The Rules of Syllogiſms.*

Foraſmuch as all *Concluſions* cannot be deduced from any Premiſſes: There are ſome Common Rules, which are to be obſerved in all *Syllogiſms*.

XIV. *The Firſt.*

The Firſt is this, *The Middle Term muſt be diſtributed, that is, it cannot be twice taken particularly, but muſt once at leaſt be taken generally.*

For ſhould the *Medium* be twice taken particularly, as it muſt be when the *Premiſſes* are particular, it may be taken for divers parts of the ſame *Whole*; becauſe Particulars are diſtinct, and ſo nothing will be concluded, or at leaſt nothing neceſſarily concluded. Which is ſufficient to make an *Argumentation* faulty, ſince that only is called a good *Syllogiſm*, whoſe *Concluſion*, if the *Premiſſes* be true, cannot be falſe. And therefore this *Argument*,

Some Body is Triangular,
Some Body is Spherical;
Therefore ſome Spherical Body is Triangular.

For ſince *Body* is taken here for divers parts of *Bodies*, a Spherical cannot be joyned with a Triangular; becauſe the ſame Body which is *Spherical*, cannot alſo be *Triangular*.

XV. *The Second Rule.*

The Second, *From pure Negatives nothing can be concluded.* The Reaſon is, becauſe two *Negative Propoſitions* ſeparate the *Subject* from the *Medium*, and the *Attribute* alſo: Now from the ſeparation of two things from the ſame Thing, it doth not follow, that they are the ſame Thing, or that they are not the ſame Thing. As for Example, from theſe *Propoſitions* that the *Mind*, is not the *Body*, and that the *Body* is not capable of *Perception*, it doth not follow, that the *Mind* is not capable of *Perception*.

XVI. *The Third.*

The Third, *The extreams of the Concluſion, muſt not be more Univerſally taken, than they were taken in the Premiſſes.*

Wherefore when either of the Extreams is taken Univerſally, the *Argumentation* muſt needs be falſe, if it be taken particularly in the two firſt *Propoſitions*. The Reaſon of this *Rule* is deducible from the firſt, becauſe it is irregular to Argue from a Particular, to an Univerſal. For from this, that ſome Men are given to *Drink Wine*, it cannot be concluded, that all Men are given to *Drink Wine*.

XVII. *The Fourth.*

The Fourth, *The Concluſion always follows the weaker part of the Premiſſes. That is, if either of the Premiſſes be Negative, the Concluſion muſt be ſo alſo; and if either of the Premiſſes be Particular, the Concluſion muſt be Particular alſo.*

The Reaſon of this *Rule* is, becauſe where there is a Negative *Propoſition* in *Syllogiſm*, the *Medium* is removed from one of the extreams of the Concluſion, and therefore can never joyn them together, which is required to make an *Affirmative Concluſion*; and if either of the *Propoſitions* be particular, no *Univerſal Concluſion* can be deduced from them. For if the *Univerſal Concluſion* be Affirmative, the Middle Term being Univerſal, muſt alſo in the *Aſſumption* or *Minor Propoſition* be Univerſal, and therefore muſt be its Subject, ſince the *Attribute*, in *Affirmative Propoſitions*, is never taken Univerſally; wherefore the *Medium* joyned to the *Subject*, will be particular in the *Minor*; and ſo the Univerſal will be in the *Major*; for otherwiſe it would be twice particular: And therefore it will be the *Subject*, and therefore that *Major*, muſt be likewiſe *Univerſal*. So that there can be no particular Propoſition in an *Affirmative Argumentation*, whoſe Concluſion is Univerſal.

Of Complex Syllogiſms.

XVIII. *What Complex Syllogiſms are.*

From what hath been ſaid, may eaſily be underſtood what *Complex Syllogiſms* are: For they are not ſo called, becauſe they conſiſt of *Compound Propoſitions*, but becauſe the Terms of their *Concluſions* are *Complex*, and are not taken entire in each of the *Premiſſes*, in order to their being united with the *Medium*, but only one part of their *Terms*: As in this Example.

Gold is an Inanimate Thing,
Covetous Men worſhip Gold;
Therefore Covetous Men worſhip an Inaminate Thing.

In which *Syllogiſm* the *Attribute* of the Concluſion is, *Worſhip an Inaminate Thing*, whereof only ſome part is put in the *Major*, *viz.* an *Inaminate Thing*, and *Worſhip* in the *Minor*.

XIX. *Complex Syllogiſms are to be reduced.*

Theſe *Syllogiſms* in the Converſation and Diſcourſes of Men, are more frequent than Incomplex ones, which are ſeldom or never uſed, except it be in the *Schools*? For who ever in common *Speech*, heard a Man Diſcourſe at this rate: *Every Stone is a Body, A Diamond is a Stone; therefore a Diamond is a Body.* And tho' *Complex Syllogiſms* ſeem at the firſt ſight, to deviate from the *Rules* of *Figures*, yet they appear to be true, when they are reduced to Incomplex ones. For this *Syllogiſm*, *The Scripture Commands us to Honour Kings.*

Charles

Charles *the Second is a King,*
Therefore the Scripture Commands us to Honour Charles *the Second.*

Tho' it be in the *Second Figure*, in which it is repugnant for all the *Propositions* to be *Affirmative*, yet it is for all that a true *Syllogism*, becauſe in this *Propoſition*, *The Scripture Commands us to Honour Kings*; the word *Kings*, is taken for all *Kings* in particular, and therefore *Charles* the Second is reckoned amongſt them, that are to be Honour'd. Beſides *King*, which is the *Middle Term*, is not the *Attribute* in this Enuntiation; *the Scripture Commands us to Honour Kings*, tho' it be united to the *Attribute Commands*. For that which truly is the *Attribute*, is affirmed and agrees: But *King* is neither affirmed, nor agrees, that is, it is not here annexed to *Scripture*, which is the Subject. Again, the *Attribute* is reſtrain'd by the Subject, but the term *King*, is not reſtrain'd in this Propoſition; *The Scripture Commands us to Honour Kings*, becauſe it is taken Univerſally. Wherefore we muſt ſay, that it is the Subject of another *Propoſition* involved in it, as if I ſhould ſay, *The Scripture Commands that Kings be Honoured.* So that this whole *Argument* conſiſts in theſe *Propoſitions*,

Kings are to be Honoured,
Charles *the Second is a King*;
Therefore Charles *the Second is to be Honoured.*

And therefore this Propoſition, *The Scripture Commands*, which before was look'd upon as Principal, is only incident to this *Argumentation*, and is joyned to the *Affirmation*, to which the *Scripture* is added as a Proof. Whence it is manifeſt, that this Argument is of the *firſt Figure*, and in *Barbara*, becauſe that Singulars are eſteemed Univerſals, when they are made uſe of in their whole Latitude.

CHAP. XVII.

Of conjoynd or Compound Syllogiſms.

I. *What is required to make a Compound Syllogiſm.*

Conjoynd or *Compound Syllogiſms* are thoſe in which the *Major* is ſo compounded, that it contains the whole Concluſion. And becauſe the *Major Propoſition* of ſuch *Syllogiſms* is four-fold, *viz.* Conditional, Copulative, Disjunctive and Proprotional or Analogical, therefore they conſtitute four kind of *Syllogiſms*, *Conditional*, *Copulative*, *Disjunctive*, and *Analogical.*

II. *Conditional Syllogiſms.*

Conditional Syllogiſms are thoſe in which the *Major Propoſition* is Conditional, and contains the whole Concluſion, As

If the Soul of Man be Corporeal, it may be divided into Parts,
But the Soul of Man cannot be divided into Parts,
Therefore it is not Corporeal.

The Major conſiſts of two *Propoſitions*; the firſt is the Antecedent, *If the Mind of Man be Corporeal*; the ſecond, the Conſequent, it *may be divided into Parts.*

III. *The twofold Figure of Conditionals.*

The *Figure* of *Conditionals* may be two-fold; the firſt is, when the Antecedent of the *Major*, or *Principal Propoſition*, is put in the *Minor* or leſs *Principal*, ſo as that the Conſequent of the ſame may be put into the Concluſion; as in this *Syllogiſm:*

If created things cannot ſubſiſt of themſelves, it is neceſſary that they be preſerved by God,
But created things, cannot ſubſiſt of themſelves,
Therefore it is neceſſary that they be preſerved by God.

IV. *The Maxim of the firſt ſort of Conditional Syllogiſms.*

And this ſort of Argument is founded upon this Maxim; *where the Antecedent is put the Conſequent muſt be put alſo.*

The other *Figure* is when the Conſequence of the ſaid *Major Propoſition*, is taken away, that the Antecedent may be taken away alſo; As,

If John *doth Marry this Woman, he is unwiſe,*
But John *is not unwiſe,*
Therefore John *doth not Marry this Woman.*

V. *The Maxim of the other ſort of Conditional, Syllogiſms.*

This kind of *Argumentation* is founded on this Maxim; *Where the Conſequent is taken away, the Antecedent muſt be taken away likewiſe.* Now to put the *Antecedent* or *Conſequent*, is to Affirm that which is *Affirm'd*, and to *Deny* that which is *Denied*: And to take them away, is to *Deny* that which is *Affirm'd*, or *Affirm* that which is *Denied.* Or to ſpeak more diſtinctly, to *put*, is to Affirm the *Antecedent* that hath been Affirm'd, or to Deny the *Antecedent* that hath been Denied; and on the contrary to *remove*, or take away, is to Deny the Affirm'd Conſequent, or to Affirm the Denied Conſequent. So that he alſo takes away that Affirms, that which was Denied before. As for Example, *If an Angel hath not Organs, he doth not Feel: But he hath not Organs, Therefore he doth not Feel*, Is a *Syllogiſm* deduced from the *Poſition* of the *Antecedent*, to the *Poſition* of the *Conſequent*, notwithſtanding that it proceed by way of Negation.

VI. *Conditional Arguments may be faulty two manner of way.*

Conditional Arguments become faulty, theſe two manner of ways; the one is when from a true *Major*, a falſe Concluſion is deduced: As when the *Antecedent* is inferred from the *Conſequent*: As if one ſhould ſay,

If a Stone be a Living thing, it is a Subſtance,
But a Stone is a Subſtance,
Therefore it is a Living thing.

And another way, when from the *Negation* of the *Antecedent*, is inferred, the *Negation* of the *Conſequent*; As in the ſame Example,

If a Stone be a Living thing, it is a Subſtance,
But a Stone is not a Living thing,
Therefore it is not a Subſtance.

VII. *What Copulative Syllogiſms are.*

Copulative Syllogiſms are only of one ſort, as when in a *Copulative Propoſition Negative*, one part is put, to take away, or remove the other: As,

The ſame Body cannot be at the ſame time, both Round and Plain;
But the Earth is Round,
Therefore it is not Plain.

Becauſe theſe *Syllogiſms* do not neceſſarily conclude, when one part is taken away, and the other is put in its place; as appears in this *Argument*, taken from the ſame *Propoſition.*

The ſame Body cannot be both Plain and Round,
But the Earth is not Round,
Therefore it is Plain.

VIII. *What Diſjunctive Syllogiſms are.*

Diſjunctive Syllogiſms are ſuch whoſe firſt *Propoſition* is *Diſjunctive*, that is, whoſe Parts are joyned with the *Diſjunctive*, *or*, *either.*

Death happens to Man either by default of the Soul, or of the Body;

But it doth not happen by default of the Soul,
Therefore by default of the Body.

IX. *Their Figure is twofold.* The *Figure* of *Diſjunctive Syllogiſms* is twofold; the one, when one part is taken away, that the other may be put; as in the Example before alledg'd: The other, when one part is put, that the other may be taken away: As,

They who firſt gave us an account of Antipodes,
either ſpoke the Truth, or impoſed upon us;
But they ſpoke the Truth,
Therefore they did not impoſe upon us.

A *Diſjunctive Syllogiſm* is grounded on this Principle, that *two Contradictions cannot be true at the ſame time.* Wherefore it is neceſſary, that the Parts of a *Diſjunctive Propoſition* muſt be Repugnant, ſo as that when one is put, the other is remov'd; and when one is remov'd, the other is put, as in the alledged Examples. When it happens, that there be more Parts of the Disjunction than two, one of them muſt be oppoſed to all the reſt; as if one ſhould make this *Propoſition:*

It is either Winter, *or* Summer, *or* Spring, *or* Autumn,

One part only muſt be put in the *Aſſumption* or *Minor Propoſition*; that ſo in the Concluſion, the reſt may be taken away; As thus,

It is Winter, *therefore it is neither* Summer, *nor* Spring, *nor* Autumn,

Or elſe the reſt muſt be taken away in the *Aſſumption*, that one Member may be put in the Concluſion; thus,

It is neither Summer, *nor* Spring, *nor* Autumn, *therefore it is* Winter.

X. *How Analogical Syllogiſms are formed.* To theſe we may add *Proportional* or *Analogical Syllogiſms*, in which the *Analogy* and *Proportion* is dilated, or *Adjuncts* are explained. For *Proportions* here ſpoken of is nothing elſe, than the agreement of *Relatives*. As when from four *Relatives*; as for Example, four Numbers, 2,4,3,6, we ſay that the ſame is the Relation of the half, and double, between 2 and 4, as between 3 and 6. Or when in a *Triangular Figure*, conſidering the two Angles of it, and the two oppoſit Sides; we aſſert the Relation of Equality and Inequality to be the ſame, as there is between Side and Side. The Firſt and Third, are by *Geometricians* commonly called *Antecedents*, as the Second and Fourth *Conſequents*, becauſe they follow from the former.

XI. *What Analogical Syllogiſms are.* SYLLOGISMS are called *Proportional* or *Analogical*, when the *Proportion* ſet down in the *Major Propoſition*, is protracted, or dilated: Which then happens, when the *Conſequents* in the *Minor*, being taken for *Antecedents*, are further referred to other *Conſequents*: And then conclude, that there is alike Proportion between the firſt *Antecedents*, as between the latter *Conſequents*. As when we ſay, 2 are to 4, as 3 are to 6, and 4 are to 8, as 6 to 12. Therefore 2 are to 8, as 3 to 12. Becauſe in this way of Diſcourſe, it is made clear, that 4 and 6, which are the *Conſequents* in the *Major Propoſition*, are made the *Antecedents* in the *Minor*: And becauſe the Relates are the Middle Terms, to which the Extreams (*viz.* the *Antecedents* and *Conſequents*) are joyned, therefore we infer, that the Extreams themſelves, agree alſo. And ſuch *Syllogiſms* as theſe, are ſaid to *conclude equally*; foraſmuch as in them, both the Relations as they begin in the ſame manner, ſo likewiſe they proceed and end, in the ſame manner.

XII. *The Second way of forming Proportional Syllogiſms.* *Analogical Syllogiſms* are alſo formed in this manner, when after that a like Proportion hath been ſet down in the *Major Propoſition*, an *Adjunct* is taken up in the *Minor*, by which the *Proportion* is rendred more evident, which therefore ſo agrees to one *Antecedent*, with reſpect to its *Conſequent*, that thence we conclude, that it alſo agrees with another *Antecedent*, with reſpect to its *Conſequent*. For if one ſhould call at Pleaſure two Sides of a *Triangle*, A,B, and the two oppoſit *Angles*, C,D, and then argue thus: The Side A is to the Side B, as is the Angle C to the Angle D; but the Angle C is greater than the Angle D; therefore the Side A is greater than the Side B. For by this Term *Greater*, it is clearly explained wherein the Proportion conſiſts.

XIII. *The Third way.* Thirdly, *Proportional Syllogiſms* are made by the *Commutation of Proportions*; *viz.* when a Proportion being ſet down in a like manner in the *Major Propoſition*, the *Minor* is paſt by in Silence, and the *Relates* are ſo inverted, that they are mutually concluded of each other. This way of Arguing is often uſed by *Geometricians*, and more eſpecially by *Arithmeticians*: As when they reaſon thus; There is the ſame Proportion betwixt 2 and 4, as betwixt 3 and 6, and therefore 4 are to 2, as 6 are to 3; becauſe that Maxim is implicitly underſtood, that *Like things agree with their Like reciprocally.*

CHAP. XVIII.

Of Imperfect Argumentations.

I. *What Imperfect Argumentations are.* SOme Argumentations are called *Imperfect*, not with reſpect to the Matter whereof they are compoſed; but with regard to the *Form*, which is not ſo exact in them, but leſs digeſted than that of a *Syllogiſm*. For in theſe the Antecedent conſiſts expreſly but of One Propoſition, or of Many: Such are *Enthymeme*, *Induction*, *Example*, *Sorites*, and *Dilemma*.

II. *What an Enthymeme is.* An ENTHYMEME ſeems to have taken its Name from this, that it expreſſeth only One *Propoſition*, and ſuppreſſeth the other, as being too clear and obvious, and which is eaſily underſtood by thoſe we diſcourſe with. This way of Arguing is very common among Men, who in their uſual Reaſoning commonly ſuppreſs the *Propoſition*, as ſuppoſing that they to whom they ſpeak will eaſily ſupply it: As when we ſay,

I was able to ſave thee,
And therefore alſo to ruin thee.

In which *Argumentation* there is only one of the Premiſſes expreſs'd, and the other ſuppreſt or imply'd, which when added it affords this *Perfect Syllogiſm.*

Whoſoever was able to ſave thee, was alſo able to ruin thee;
But I was able to ſave thee,
Therefore I was alſo able to ruin thee.

III. *Induction.* INDUCTION is an Argumentation, which from many *Singulars* concludes an *Univerſal*: As,

This Triangular conſiſts of three Lines, and ſo doth that likewiſe, and all the reſt; therefore every Triangle conſiſts of three Lines.

To

To this way of Reasoning it is required, that it contain an enumeration of all the *Species* and *Parts*; for if but one be wanting, it admits of an Exception, and subverts the whole *Proposition*. Wherefore nothing can certainly be proved by *Induction*, except the same be whole and compleat in all its Parts, and so General, as to admit no Exception, which is very difficult, and almost impossible. For who can recollect in his Mind all the Cases of *Law?* or what Student of Natural Philosophy, can reckon up all the several kinds of *Bodies*, all *Plants*, *Animals*, *Stars*, *&c.?* Are not almost all Men of Opinion, that *Heat* dilates, and *Cold* contracts? Yet when we search more narrowly into the matter, we find that when *Water* is frozen, it takes up more space than when it is not frozen? Wherefore in cases where the greatest part of Particulars is only known, we can infer no more but thus; that *for the most part it is so:* Tho' sometimes we meet with some Special Cases, which swerve from the Common Rule. So from many Experiments we conclude, *Snow to be white*, *a Crow black*, and *Honey sweet*; notwithstanding that in some Countries there be found *red Snow*, *white Crows*, and *bitter Hony*.

IV. *What Example is.* EXAMPLE is a kind of *Imperfect Argumentation*, whereby from one *Singular* we gather another, because of a likeness of Reason that is between them. As when from this, *That* Cæsar *subdued the People of* Rome *more by his Clemency, than by his Arms*; I gather, that a Prince ought rather to have recourse to *Clemency*, than to *Arms*, for the reducing of his Subjects. Or when considering that others, by serious Meditation have arrived to some degree of Learning; I infer, that I my self also may arrive at the same by closely following my Studies, and by an attentive Consideration of the Things I undertake to examine.

V. *Argument from Authority.* To an *Example* belongs that which is called an *Argument from Authority*; which is, when we make use of the Testimony of one or more, to infer a Conclusion; whose force depends of a concealed, but yet imply'd Proposition: As when a Man saith, *Archimedes, and other famous Mathematicians assert, that the* Sun *is many times bigger than the* Earth: *Therefore we ought to hold the* Sun *to be many times greater than the* Earth. For here this *Proposition* is understood, That *every man ought to be belived in his own Art and Profession:* Or we are to take that for Truth, which *Archimedes*, and the most Learned *Mathematicians* do assert of their own Art.

VI. *Sorites.* SORITES, is an *Argumentation* consisting of many Propositions so disposed, that the *Predicat* of the foregoing Proposition becomes the *Subject* of the following; whence the last *Predicat* is in the Conclusion attributed to the first *Subject:* As in this Example, *Covetous persons desire many things*, *They who desire many things want many things*, *They who want many things are miserable*; *therefore Covetous men are miserable.*

VII. *When a Sorites doth not conclude truly.* This Argument doth not conclude truly, but when whatsoever is said of the *Attribute*, is likewise said of the *Subject:* Wherefore this *Ratiocination*, *Salt-meat excites to drink, and by drinking Thirst is extinguish'd*; *therefore Salt-meat extinguisheth Thirst*, is faulty: Because *Salt meat* only by Accident invites Men to drink, forasmuch as it eaves a dryness in the Throat, which causeth drinking.

VIII. *What a Dilemma is.* A DILEMMA is made by the *Disjunction* of many Propositions opposite to one another, whereby the Answerer is so shut up, that there is no way left for him to avoid the dint of it, which part soever he chooseth: As suppose a Man should accuse another of a Crime he hath committed, thus; *Either you did know your self to have offended against the King, or not; if you did know it, how durst you violate the Law of Majesty? If you did not, why did you run away?*

IX. *A Dilemma may be faulty two manner of ways. The First.* A *Dilemma* may be faulty two manner of ways: One, when the *Disjunctive Proposition* wherein it is founded doth not contain all the parts of the thing divided: As if a man would prove, That one ought not to Marry, by this way of Arguing; *If you marry a Wife, she will be either Beautiful or Deformed; if Beautiful, she will make you Jealous; if Deformed, you will loath her; therefore you ought not to marry at all.* The Mistake is, because there are *Women* who neither are so Beautiful, as to cause Jealousie; nor so Deformed, as to cause Loathing.

X. *The Second.* In the Second place, a *Dilemma* is vicious, when the particular Conclusions of either part are not necessary: Thus it doth not follow that a *Beautiful Wife* must needs make her *Husband* Jealous, forasmuch as she may be so Prudent and Chaste, as not to give the least occasion to doubt of her Vertue. Neither is it necessary that a *Deformed Wife* should be displeasing to her *Husband*, because her Deformity may be made up by her Vertue and Ingenuity, which may render her very grateful to her *Husband.*

XI. *What is to be observed in a Dilemma.* He that makes use of a *Dilemma*, must take care that it be such as may not be retorted upon himself, which it is said *Protagoras* did; to whom *Euathlus*, his Disciple, having promised a certain Sum of Mony in consideration of his instructing of him, to be paid on that Day when he should first get the better in the Cause he pleaded; and taking that for his first Cause, to plead whether he was to pay that Sum of Mony he had promised him, made use of this *Dilemma: Either I shall lose this Cause, or I shall win it: If I lose the Cause, then according to our Agreement, I am to pay you nothing; if I win it, then I shall owe you nothing by the Sentence of the Judges.* Which Argument *Protagoras* thus retorted; *Either you will lose this Cause, or win it: If you lose it, you will by Sentence be obliged to pay me; if you win it, you must pay me according to the Tenour of our Agreement.*

CHAP. XIX.

Of Demonstration, a Topical Syllogism and Sophistical.

I. *How Science, Opinion, Faith, and Error are distinguish'd.* FOr the better understanding of the following Discourse of *Apodictical*, *Topical*, and *Sophistical Syllogisms*, it is necessary that we first explain the Nature of *Science*, *Opinion*, *Error*, and *Faith*; that by exhibiting their distinct Notions, the Principles from whence they are derived may be the better known.

II. *What Science is.* SCIENCE is the certain and evident knowledge we have of any thing: For whatsoever is so evident to us, that we are certain of it, that we are said to know, or have the *Science* of. Accordingly the knowledge of a Conclusion is certain and evident,

dent, when the *Premisses*, whereon as *Principles* it doth depend, are so.

III. *What Opinion is.* OPINION, is a Knowledge that is not altogether certain, but joyned with some fear or wavering of the Intellect, in its assent to it. For *Opinion*, tho' it be a true assent to the Conclusion, yet is it doubtful and uncertain; and such an assent as this is the Effect of a *Dialectical Syllogism*, as *Science* is the Effect of a Demonstrative, or Apodictical *Syllogism*.

IV. *What Error is.* ERROR is an Opinion opposite to *Truth*, that is, a False one.

V. *What Faith is.* FAITH is a Persuasion founded upon the Testimony of another, which may be either true or doubtful, according to the different Authority it rests upon. So the *Faith* we have to God is most firm and stable, because we know him to be True, and that to Lye is repugnant to his Nature. But the *Faith* we have to a Man, hath always something of Uncertainty joyned with it; since there is no man but can deceive another, if he please.

VI. *How we may distinguish the several kinds of knowledge.* If in considering any *Axiom*, the truth of it do immediately appear to us, from the Evidence that is found in it, without any further Proof or Disquisition, this kind of *Knowledge* we call INTELLIGENCE: And thus we know *first Principles*. But if by its own proper Evidence, it cannot engage the *Understanding* to assent, then we must have recourse to other Motives, by which the Intellect may be convinced of its Truth: Now these Motives can be no other, but *Reason* and *Authority*. If *Authority* engageth us to assent to the things Propounded to us, this is that we call *Faith*: But if *Reason* sways us, then either that *Reason* leaves some fear behind it, whereby we are made doubtful of the certainty of the thing, and then this assent is called *Opinion*: Or the *Reason* doth satisfie fully the Understanding, and then it is either *Seemingly* only Evident, for want of due Attention, and thence comes *Error* in case it be really false; or at least a *Rash Judgment*, if we take it to be true, before we have sufficient grounds of giving our Assent to it: Or if the *Reason* proposed to us, be not only seemingly true, but evidently so, and be clearly and distinctly perceived by our Understanding, then the Conviction produced in our Mind by this *Reason*, is called *Science*.

Forasmuch therefore as *Demonstration* begets *Science*, and that the Conclusion of a *Demonstration* is *Science*, we will first Treat of it, and afterwards in order, of those things that produce *Opinion* and *Error*.

VII. *What Demonstration is.* DEMONSTRATION is a *Syllogism* consisting of *Premisses* that are *True, Immediate, Prior, more known and causes of the Conclusion*. Those *Propositions* are said to be True and Immediate, which have their Evidence from themselves, and not from any other thing: And which are known by their Terms: As, *Every thing is, or is not*. For there is an Inborn Power or faculty in us, whereby we assent to first *Principles*. Wherefore we should never give our assent to the Conclusion, except the *Premisses* appeared evident to us; neither do we assent to the Conclusion, but because we believe the *Premisses* to be true; and therefore it is necessary that the *Premisses*, be more known than the Conclusion, according to that saying; *That for which any thing is such, is more such it self.*

VIII. *Demonstration is twofold either à Priori, or from the Cause.* *Demonstration* is twofold, the one *à Priori*, and the other *à Posteriori*. *Demonstration à Priori* (which alone, to speak properly, is *Demonstration*) is that in which the Effect is Demonstrated by its Cause: As when we prove the *Existence* of *Light*, by the *Existence* of the *Sun*. Or when *Geometricians* prove that round Wounds are longer a Healing, than such as are of a long Figure, forasmuch as in those, the Sides are further distant than in these.

IX. *Demonstration à Posteriori, or from the effect.* *Demonstration à Posteriori* is when we Demonstrate the Cause by the Effect: As when from the *Existence* of *Light*, we Demonstrate the *Existence* of the *Sun*. When we prove the *Heaven* to be Fluid and Corruptible, from the various Things that are Generated in it; as from the *Comets* that are found in it; from the *Spots* about the *Sun*, and from many *Stars*, which for some time shew themselves there. To this kind of *Demonstration* may also be reduced the *Demonstration* which is made from the remote Cause, as when one proves that a *Stone* doth not breath, because it is not an *Animal*, when it would have been more proper to have proved it by this, because it hath no Lungs. For the having of Lungs is the near cause of *Respiration*, and not the being an *Animal*; nay it will be found that to have Longs is not the property of an *Animal*, since there are many *Animals* that have no Lungs, as *Oysters, &c.*

X. *Of Ostensive Demonstration.* Antient *Authors* make mention of another kind of *Demonstration*, which they call *Ostensive*, by which a thing is Demonstrated from proper *Principles*, directly and by it self. As if a Man, when a right Line is given, and a *Semidiameter* made of two *Circles*, and two other right Lines, to one of the Intersections of the *Circles*, drawn from their Extreams, and by these three Lines a *Triangle* is made, should prove Ostensively that this *Triangle* is *Equilateral*, or hath all its Sides alike, by shewing that the two last Lines are even, or of the same Length, because they are equal to the same Line given; and that they are equal to the same Line given, because both of them separately proceed from the same Center, to the same Circumference with it.

XI. *Demonstration by Deduction to an inconvenient.* To this they have added another kind of *Demonstration*, which they call *Deductive to an inconvenient*; which tho' it be inferiour to the former, yet may be of use, where we cannot have an *Ostensive Demonstration*, as being also of insuperable necessity. And this is when we demonstrate a thing to be so, because if it should be otherwise, either an Absurdity, or an Impossibility, or a contradiction must necessarily be granted: Such as is, *That the Effect doth not depend on the Cause*; And *that the thing containing is less, than the thing contained*, and the like. As if by Deduction to an inconvenient he would prove the aboveSaid *Proposition* from hence, because no Side can be admitted to be equal to another; but at the same time it must be granted, that all Lines drawn from the Center to the Circumference are equal; or that two things which are equal to one thing, are not equal between themselves.

XII. *What a Topical Syllogism is.* A TOPICAL SYLLOGISM, which is also called *Suasory*, or *Opinable*, is that which *concludes from Probables*: Or whose *Premisses* do not hold forth, a necessary Connexion of the Subject, with the Middle Term, or of the Middle Term with the Attribute. For tho' the Conclusion it proves, partaks more of Evidence than Obscurity, yet it leaves something of doubt or *Hesitation* behind

hind it, which makes that the understanding cannot assent without some Scruple. And therefore 'tis commonly said that a *Topical Syllogism* doth persuade indeed, but doth not force one to assent as a *Demonstration* doth.

XIII. *What things are called probable.*

Those things are called *Probable*, which seem to be so to all, or to the most, or to the Wise, or at least to the most, or most considerable amongst them: As it seems *Probable to all*, that the approaching *Summer* will be *Hot*, yet it is not certain, forasmuch as it sometime happens that the *Summer* is very *Cold*. *It appears to most, that Physick is necessary for the Curing of Diseases*, whereas, notwithstanding it often happens, either through the Ignorance of the *Physitian*, or through Default of the *Patient*, the Distemperature of the Air, or the Unhealthfulness of the Place, that a *Medicin* may do more hurt than good. It appears to *Wise Men*, that *Learning* ought to be desired by all; when notwithstanding there be many found that despise it, and who prefer their *Ignorance* before *Learning*. The *most considerable Men*, are of Opinion that the *Earth* is moved, and that the *Sun* stands still in the midst, and yet there are many that oppose this Opinion, and maintain the contrary.

XIV. *How a Topical Syllogism is distinguisht from all others.*

Wherefore all those *Syllogisms*, whose *Premisses* are *Contingent*, and do not infer a necessary Connexion between the *Subject*, and the *Middle Term*; or between the *Middle Term*, and the *Predicate*, are called *Topical*, that is, *Local* or *Probable*. The former from the *Places* whence their *Proofs* are taken, the latter from the likelyhood of them.

XV. *What a Sophistical Syllogism is.*

A SOPHISTICAL or *Paralogistical Syllogism*, which with one Word is called a *Sophism*, is a *Syllogism* consisting of false *Propositions*, which yet have an appearance of *Truth*: Or is a *Syllogism*, that begets Error. As for Example, this *Syllogism*,

All Lines drawn from one Point to another are Equal;
But a Right and a Crooked Line, may be drawn from the same Point, to the same Point;
Therefore a Right and a Crooked Line are Equal.

XVI. *Of the various ways of deception in Sophitical Syllogisms; and first of the Fallacy in Words.*

All *Fallacy* or *Deception*, is either in the very Form of the *Argument*, or in the Words, or in the Things. As to the Form of *Argumentation*, we have already largly Treated, in Chapter XVI. As for the Cavilling which consists in Words, that is callen *Fallacia Dictionis*, or *Fallacy* in *Words*, which frequently consist in the Homonymy of the *Words*, when things altogether different are signified with the same *Word*. Sometimes also in the Ambiguous context of the Speech, and then it is called *Amphibology*; Examples of which kind, do also occurr amongst the best of Authors.

XVII. *The Fallacy from a conjoyned Sense to a divided, and on the contrary.*

There is another *Sophistical* way of Arguing, *from conjoynd Things, to those that are divided*; and on the other Hand, *from Things divided to those that are conjoynd*. This hath given occasion, to that Distinction of a Divided and a Compound Sense. The former is, when a *Faculty* or *Power* is joyned with an oppsite Act; as the *Faculty* of *Laughing*, with the Act of *Weeping*; for this Proposition, he that *Weeps* can *Laugh*, is true in a Divided, though not in a Compound Sense. But a Compound Sense is, when two oppsite Acts are united together; and thus, this Proposition, *He that Laughs cannot Weep*, is true in a Compound, Though not in a Divided Sense.

XVIII. *The Fallacy from the second Intention to the first.*

There is a Third way of *Cavilling*, when we Argue from Second intentions, to First; as thus; *A Circle is a Figure; But Figure is a Genus, therefore a Circle is a Genus.*

XIX. *From a Relative to an absolute Expression.*

The Fourth is *à Dicto secundum quid*, from a Relative Expression, *ad Dictum simpliciter*, to an absolute Expression; As if a Man should Argue, that because *Blackamoors* are *White*, with repect to their *Teeth*, therefore they are absolutely *White*; or because *Wine* is for the most part Hurtful to Sick Persons, should conclude *Wine* to be absolutely Hurtful.

XX. *Ignorance of the matter in Question.*

The Fifth is that which is called *Ignoratio Elenchi*, or Ignorance of the matter in *Question*, which is, when another thing is proved, than that which is denied by the Adversary.

XXI. *Petition of the Principle.*

The Sixth is *Petition* of the *Principle*, when the Point indispute is taken for granted. As if one should go about to prove that the *Earth* doth rest, because the *Sun* is moved: that being the *Principal* thing in Question, whether the *Sun* be moved.

XXII. *From a No cause to a Cause.*

The Seventh is taken *à Non Causa ad Causam*, from *a No Cause to the Cause*, as when that is brought in for a Cause, which is no Cause at all: As when we refer the changes of times to the *Moon.*

XXIII. *From a manifold Question.*

The Eighth way of Cavilling, proceeds from a *manifold Question*, which is, when many *Questions* are so Propounded, that they look like one only. As if one should ask, whether the *Sun* and *Earth* are moved.

XXIV. *The manner how to avoid Sophisms.*

There is no safer way to avoid these Captious *Sophisms*, than to define the Words themselves, in case of a *Fallacy* from *Equivocation*, or *Homonymy*. Neither are we only diligently to consider, what the thing in *Question* is, but also, what is the *Attribute* of the *Question*, and what Relation and Order it hath to the *Subject* it self. For it is of great importance, whether the *Attribute* be *Universally* by it self, and primarily *Attributed* to every *Subject*, or that it agree to some one only, or by *Accident*. In like manner, whether the *Attribute* be spoken of the *Subject* simply, that is, absolutely, or with respect to something: All which particulars may be easily known, from what hath been already said.

The Places from whence the Middle Term is Fetch'd.

XXV. *What the Places are from which the Middle Term is fetch'd.*

We come now to the General Heads, or as the *Rhetoricians* call them, *Places* of *Arguments*, to which the Proofs which we use in any matter, may be reduced. For as some *Syllogisms* are *Demonstrative*, others *Opinable* or *Opinionative* and *Suasory*, and others again *Paralogistical* or *Erroneous*, so there must be divers Places, whence the *Middle Term* or *Argument* may be Fetch'd.

XXVI. *The Middle Term in a Demonstrative Syllogism, may be the Genus.*

For in a *Demonstrative Syllogism*, the *Middle Term* agrees with the Subject, and the Attribute with the *Middle Term*, as a *Genus*, or a Propriety, or a Definition, or a Cause acting necessarily, and the like. As if a Man should have a Mind to Demonstrate that a *Mote* in the *Sun*, is indefinitely divisible, he may take the *Genus* for his *Middle Term*, and argue thus: A *Mote* is a *Body*, but a *Body* is indefinitely divisible, therefore a *Mote* is indefi-

finitely divisible. The Minor is to be suppos'd from *Natural Philosophy*.

XXVII. *Or a Propriety.* So to demonstrate a Mans being *Rational*, we may take his Property, which is the Faculty of Speaking, and Reason thus: The *Power of Speaking*, that is, the Faculty of expressing ones Mind by Words, Signs, or Gestures, *belongs to Man*; *But whatsoever enjoys this Faculty doth partake of Reason*; *therefore* Man *doth partake of Reason*.

XXVIII. *Or a Definition.* So likewise a *Definition* may serve for a Middle Term, to prove that *Oysters* are *Animals*, thus: *Oysters are Bodily things, endued with life and motion: But whatsoever hath life and motion is an Animal*; *therefore Oysters are Animals*.

XXIX. *Or a Cause.* And so also a *Cause* acting necessarily, may be the Middle Term; for thus a *Lunar Eclipse* may be proved from its Efficient Cause, *viz.* the *Sun* and *Moon* being placed in opposite *Nodes*, or in the Intersections of their *Orbs*, after this manner: It is necessary for the *Moon* to be Eclipsed, as often as the Globe of the *Earth* interposeth between the *Moon* and the *Sun*, from which the *Moon* borrows her *Light*; but then the Globe of the *Earth* interposeth between the *Moon* and the *Sun*, when the *Sun* and *Moon* are in opposite *Nodes*; (because at that time they are Diametrically opposite, and the *Earth* plac'd in their Diameter) therefore there must necessarily be an Eclipse of the *Moon*, when the *Sun* and *Moon* are constituted in their *Nodes*, or the opposite intersection of their *Orbs*.

XXX. *The Middle Term in a probable Syllogism, may be fetch'd first from the Genus.* We make use also of like places in a *Probable* or *Suasory Syllogism*; yet so as that tho' the *Middle Term* agree to the Subject, (yet the *Attribute* does not to the Middle Term, as a *Genus*, *Propriety*, *&c.* as before:) As if a Man to prove *Rhetorick* to be profitable for Mankind, should argue thus; *Rhetorick is an Art, but every Art is profitable to Mankind*; *therefore Rhetorick is profitable to Mankind*. In which *Syllogism*, the Middle Term *Art*, is indeed the Genus of the Subject *Rhetorick*; but the Attribute *is profitable*, is not its Genus, but only a contingent Adjunct, or common Quality; and therefore neither doth the Mind assent to it without something of Doubtfulness, whether or no *Rhetorick* may not be reckon'd amongst those Arts, which tho' they be accounted Subtil, yet are esteemed by some as unprofitable, or at least indifferent.

XXXI. *From a Propriety.* In like manner one may prove, from a *Propriety* of *Logick*, that *Logick* is a thing desirable, thus: *It is the Property of Logick, to direct the Mind in the knowledge of things*; *but what directs the Mind in the Knowledge of things, is something desirable*; *therefore Logick is a thing desirable*. This Argument also leaves some hesitation in the Mind, because the directing of the Mind in the Knowledge of Things, doth not necessarily conclude the thing to be desirable; because there are many who rather desire to continue in their Ignorance, than to be instructed in *Logick*.

XXXII. *From the Cause.* We may also argue from the *Cause* thus: *This Picture is drawn by* Apelles; *but the Pictures drawn by* Apelles *are very exact: Therefore this is an exact Picture*. Which enforceth only a Probable, but not a certain Conclusion; because the best *Painters* do not always Paint alike, nor so exactly, but that sometimes Faults may be spied in their *Works*.

XXXIII. *Ambiguity is the only place for a Sophistical Syllogism.* A *Paralogistical*, or *Sophistical Syllogism*, has but one only place, *viz. Ambiguity*; which being once detected, its Imposture lies open; and that which seem'd to be a good *Syllogism* appears to be none at all. Because the Reason of *Syllogism* requires, that it have only one Middle Term, one Subject, and one Attribute; whereas in a *Sophistical Syllogism* there are two *Subjects*, and as many *Attributes* without a Middle Term: As when a man Argues, *some Mountain is* Taurus, Taurus *is a Lowing Animal: Therefore some Mountain is a Lowing Animal*. For the Ambiguity here lies in the word *Taurus*, which agreeing to two different things, is in the Major taken for a *Mountain*, and in the Minor for a *Four-footed Animal*. Whence it appears, that the word *Taurus* is no Middle Term, forasmuch as it doth not agree with the *Subject* and *Predicate*.

XXXIV. *Ambiguity is the cause of Deception in all things.* For *Ambiguity* is that which occasions deception in all things; for he that concludes, that a Man *asleep* is *awake*, because it hath been before granted, that it *is possible for a man that sleeps to be awake*, doth not do it for any other Reason, but because this *Proposition* may be understood either disjoyntedly, with respect to different times; or conjunctly, with regard to the same time. And he who concludes that the *Buyer hath eaten raw flesh*, because it may be, he confess'd that he had *eaten* what he had bought, doth so because of the Ambiguity of the words, *What he had bought*; which may either be taken only for the substance of the Flesh; or also for an Accident of it, *viz. Rawness*. And the like may be said of all *Sophistical Places*, *Amphibology*, *Composition*, *Division*, *Account*, *&c.* forasmuch as they all agree in this, that they have some *Ambiguity* either in a *Word*, or in a *Phrase*; or that one Sense is taken in the *Proposition*, and another in the *Assumption*. So that it is no wonder, that when both are admitted for True, an Absurdity follows from them.

The Fourth Part of Logick.

Concerning Method, or the Orderly Disposition of our Thoughts.

CHAP. XX.

Of the General Method of Knowing.

I. *Method is necessary to the Right forming of our Thoughts.* FOrasmuch as LOGICK was found out for the attaining of *Sciences*, and that our *Thoughts* can hardly be rightly formed without its assistance, METHOD seems to be necessary to assist and accomplish our Mind in the *Knowledge* of Things. For tho' possibly there may be some of such quick and piercing Wits, as without difficulty to dive into the Natures of Things, and to solve the most abstruse Questions; yet will he never be able to attain certain *Knowledge*, except he be first acquainted how he must direct his *Mind*, and what *Order* he must observe. Wherefore *Method* is necessary, as well to assist him in the searching out of *Truth*, as in the avoiding of *Error*, *Confusion*, and *Obscurity*. Which *Method* is nothing else, but *an Orderly disposition of things to be treated of, suitable and accommodate to the Capacity of Learners*. For it must

must be of that Nature, as not to put any force upon the *Wit* of Man, but rather pleasantly allure it, and guide and direct it by the Evidence and Easiness of its *Rules* and *Precepts*.

II. *Three things are requisite to the manner of Knowing.* This Mode or manner of *Knowing* consists in Three things: *First*, That the thing propounded may be clearly and distinctly Perceived. *Secondly*, That we judge rightly concerning the Matters we have thus clearly and distinctly perceived. *Thirdly*, That we commit to Memory the *Truths* we have discover'd, that is, the things we have rightly Perceived and Judged. By observing these Three *Precepts*, we shall relieve all the Weaknesses of our Mind, and prevent those *Errors* into which it is apt to fall. For seeing that the main Obstacles of *Science* are, either an *over-hastiness* of the Mind; the same will be removed by clear and distinct Perception; or else *Error* and *Doubt*, which will be cured by Sound Judgment; or lastly, *Forgetfulness*, which will be prevented by the Remembrance of the Things perceived and judg'd by us. It remains only to enquire, by what means this *distinct Knowledge* may be attained; and how our Mind may be brought to that pass, as never to assent to any thing which it has not before clearly perceived, and so to impress the Things she has judged of in her Memory, that she may never forget them.

III. *First, the distinct Perception of the thing.* As to the First, it is requisite, that setting aside all *Precipitancy*, we give heed to the Matter propounded, and (as it were) scan the same with our inward Eyes. In order to which, it will be proper for us to behold or contemplate one thing only at once, that our Understanding may not be distracted by the multitude of *Objects*, and lest by minding many things, our attention to Particulars may be the less. For the multiplicity of *Objects* presented to our Understanding, breeds Confusion; and as they who behold a Field, distinguish'd with variety of *Colours*, do not distinctly perceive the variety of Colours that is in it, but behold it under the appearance of one Colour only: So they who consider several *Objects* at once, cannot bestow a due attention upon every particular; and it cannot otherwise be, but that they must be promiscuously confounded in their Mind.

IV. *Wherefore we must rather set our selves to examine Simple things, than those that are Compound.* In order to attain this due *Attention*, it will be of good use to undertake the examining of a *Simple thing*, or of some *Attribute* or *Mode*: For these kind of Perceptions, whereby Simple and Incomplex things are represented to us, are more clear and distinct. As for Example, The *Soul of Man* is more distinctly perceived by us than *Man*; because the *Soul* of Man imports one Nature only, *viz.* a *Thinking Being*; whereas a *Man* comprehends two Natures, *viz.* a *Soul* and *Body*, which belong to two different *Genera*, and therefore cannot be both at once proposed to the *Intellect* without some confusion.

V. *Things Simple are to be examin'd before those that are Compound.* Accordingly *Simple things* are to be known before *Compound*, near before remote, and few before many. Thus we attain a fuller knowledge of the things that are born, if we begin the consideration of them from their first beginning. By which means the Famous *Harvey* perspicuously discovers the *generation* and *growth* of a *Chicken*, by shewing what Parts are daily formed in an *Egg*, which an *Hen hatcheth*. In like manner we arrive to a more accurate knowledge of a *Plant*, when we take a view of its *beginning*, *progress*, and *perfection*, considering it in its distinct Stages of its *budding*, *growth*, *blooming*, and *bringing forth fruit*; and the same may be said of all things that grow and increase.

VI. *Things Positive are more distinctly conceiv'd than Negative.* But forasmuch as *Substances* are chiefly known by their *Attributes*, and that many of them are found in every *Substance*, we are rather to consider those that are *Positive*, than the *Negative*. Thus the Nature of the *Soul* is more easily known by me, when I consider it as an *understanding*, *willing*, and *judging Subject*, than when I conceive it as *Immaterial*, *Incorporeal*, *Invisible*, *&c.* because Negative Attributes do not so much declare *what a thing is*, as *what it is not*. Wherefore it will also much conduce to the attaining of *Knowledge*, if we always begin our Enquiries with those things that are more Universal, and from them to proceed to Singulars: Because the *knowledge* of *Universals* doth more accomplish our Minds, than that of *Singulars*; the reason whereof is, because *Universals* are in a manner *Eternal*, as having no Original, and not being comprehended within any difference of Time or Space of *Place*, which has given occasion to that noted Axiom of Philosophers, that *Science consists in Universals, and not in Singulars*.

VII. *We must call to Mind, what hath been said in the First Part of this Discourse.* We shall the better understand all these Particulars that refer to clear and distinct Perception, by firmly retaining in our Memory, what hath been already handled in the First Part of *Logick*; because this Fourth Part is founded upon those *Rules* which are there delivered, concerning the Genealogy of things, their *Causes* and *Effects*, *Subjects* and *Adjuncts*, *Agreement* and *Disagreement of things*, *&c.*

VIII. *The Second Precept, about the manner of Knowing, is concerning Judgment.* The Second Precept about the Mode of *Knowing* is this, That our *Judgment* do always follow our *Conceptions*; that is, that we never assent to any thing which we have not before clearly and distinctly perceived: For the Order of *Reason* requires, that *Knowledge* always go before *Judgment*, and that Simple Terms make way for those that are Complex, but yet so, as that the *Judgment* we pass of any thing, may exactly answer to the *Knowledge* we have of it; as I have before hinted in the *Fourth Rule* for the *attaining of Truth*. For since the Second Operation of the *Mind*, or *Judgment*, doth involve two things, the *Subject*, and the *Predicate* or *Attribute*, it is necessary that the Nature of both be fully known to us, before we can judge whether the one do agree with the other, or dissents from it. Thus we must first have distinctly understood what the *Sun*, and what *Heat* is, before we can affirm the *Sun to be hot*, or (which is the same) that *Heat agrees to the Sun*. As to which point they do greatly mistake, who too much cleaving to the Prejudices wherewith they have been tainted from their *Childhood*, do judge according to them; because they pervert the Order of *Reason*, and do not follow their Perceptions as they ought to do, but anticipate them, and believe them to be true, before they have perceived them to be such.

IX. *What is to be done by him who is in doubt about the Matter propounded to him.* If a Man chance to doubt of the *Truth* of the thing he is enquiring into, he may easily avoid falling into any Error, by suspending his *Judgment*, and not affirming or denying any thing concerning it, until he have exactly examin'd all the Difficulties of it, and by the Rules of *Perception* have

have removed all doubts concerning it. For we muſt not think it enough, that this or the other thing appears diſtinctly and clearly to others, except it appears likewiſe to us. For ſeeing every one deſires Knowledge for himſelf, it is but reaſonable, that he make uſe of his own Underſtanding, and not of anothers; and that he paſs Judgment ſo far only, as his own Knowledge guides him. Wherefore, before we can with any ſafety give our aſſent to any thing, we muſt be certain that the thing be ſo indeed, as it is conceived by us, and not only ſo, but that it cannot be otherwiſe.

X. *There is a different certainty of Truth in things.*

Yet are not we to conceive that all things that are true, are of the ſame certainty; for ſome things are only *Contingently* true, that is, ſuch as are taken to be true by us, tho' indeed they may be falſe; as when I take a Man to be *Godly*, becauſe he is frequent at *Church*, and at *Sermons*, and is liberal to the *Poor*; all which Signs are ſufficient *Morally*, to perſuade me that he is *Godly*; tho' notwithſtanding all this, it may happen that he is not ſo. Other things again, are altogether *Certain* and *True*, as are all *Propoſitions* of Eternal Truth, which are true in that degree, that they cannot admit any ſuſpicion of *Falſhood*: Such as are theſe Propoſitions, *Twice four make Eight. Three is a number.* And therefore ſuch neceſſary Propoſitions as theſe are called *Axioms*; becauſe their Predicates agree with all their Subjects, and at all times, and according to the different degree of neceſſity, they partake and admit of ſeveral Names.

XI. *What Phyſical Certainty is.*

Some *Attributes* are ſaid to be joynd with their Subjects, by a *Phyſical* certainty, when according to the order of Nature, it is impoſſible but they muſt be joyned to them; as when we ſay, that *a Man hath two Feet*; becauſe, that tho' a Man may be conceived without Feet, yet Naturally Man is never without them. Other things are called true, by *Metaphyſical* certainty, when an *Attribute* is ſo indiſſolubly attributed to its Subject, that it cannot be conceived to be otherways: As when we ſay, *Three is a number.* And the ſame may be ſaid of ſingular *Axioms*, foraſmuch as the ſame *Definitions*, *Differences* and *Attributes* occur in them as in Univerſals. As to Judgment, the Reader may have recourſe to what hath been ſaid in the ſecond part of *Logick*, where is treated of *Judgment*, and the nature of *Propoſitions*.

XII. *The Third Precept is Memory.*

And foraſmuch as it is of little uſe to know the nature of things, except we remember them; we are alſo to be informed, how the things we underſtand, may be ſo *impreſt* on our *Memories*, that we may not eaſily forget them again. This we may eaſily procure, by following the Order of *our Method*; that is, by taking care, that we commit nothing to Memory, which we have not before throughly examined, and paſſed a right *Judgment* of. For daily experience ſhews us, that the more clearly any thing is perceived by us, the ſtronger it is impreſt on our *Memories*, and that we more eaſily remember the things, that are in order propounded to us, than thoſe which are offered to us confuſedly. For the *Memory* doth of it ſelf, and ſpontaneouſly embrace things that are clearly underſtood, and, as a Foot-boy, follows right Judgment.

XIII. *Helps of the Memory.*

But yet we may promote and aſſiſt our *Memory*. Firſt, By keeping our Mind ſtill and quiet, without ſuffering our Underſtanding to be variouſly diſtracted by multiplicity of Objects: Eſpecially if to theſe we add the deſire of Learning ſome new thing or other, or that we be excited by admiration to inſiſt the longer on the matter we deſire to know. For ſuch things as theſe we are wont more to imprint in our *Memory*. It is alſo greatly ſtrengthened by moderate Study and frequent Exercitation. For as the *Fingers* by playing upon a *Lute*, do accuſtom themſelves to ſuch and ſuch Motions, ſo by Exerciſe we attain to ability and readineſs. To which we may add, that by Study, the Species in the *Brain* become diſtinctly ranged and joyned, and by uſe alone, almoſt all obſtructions are removed. *Thirdly*, It will be a great help to our *Memory*, if the things we commit to it be not only evident, but alſo connexed, and orderly diſpoſed, and adorned with the *Circumſtances* of *Cauſes*, *Effects*, *Time*, *Place* and other ſuch like. This is the firſt office of *Memory*.

XIV. *The Office of Memory.*

It is the office of *Memory*, to retain the things we have committed to it; which we ſhall obtain by frequently repeating, and a diligent conſideration of them: As likewiſe by endeavouring to reduce Compound Things to thoſe that are *Simple*, and ſpecial things to *General*. For by this means, they will more clearly be repreſented to our *Minds*, and more firmly fixed in our *Memory*: As is apparent in thoſe *Sciences*, which from ſimple terms proceed to *Propoſitions* and *Axioms*; which without any trouble, are inſinuated into our *Minds*, and continue with us till our *Lives* end.

CHAP. XXI.

Concerning ſpecial Method; and firſt of that which is called Analytical.

I. *Another Method neceſſary to the orderly diſpoſing of our Thoughts.*

THe word *Method*, is taken more ſtrictly here than in the *foregoing Chapter*; becauſe it being there, only our deſign to inform *Beginners*, what *Order* they were to obſerve in the knowledge of *Things*; it was ſufficient to ſet down a *Method*, which might be helpful to them for this end, and point out to them the way, whereby to arrive at the diſtinct knowledge of *Things*. But here we are to handle, not only how we ought to form our Conceptions, but alſo how we ought to order and diſpoſe them, either for the diſcovering of the *Truth* we are ignorant of, or for the proving of the *Truth* we know to others.

II. *Method is twofold, Analytical and Synthetical.*

And accordingly there is a twofold *Method*, the one called *Analytical*, or the *Method of Reſolution*, which ſhews the true way, by which the thing was Methodically and Primarily invented. The other *Synthetical*, or *the Method of Compoſition*, which clearly demonſtrates what hath been concluded; but by an oppoſit way, and fetch'd *à Poſteriori*. For a whole *Science* cannot be ſet down according to *Analytical Method*, but only ſome particular *Queſtions*, about certain *Terms* or *Things*.

III. *What is to be obſerved about Terms.*

About *Terms* we may enquire, what is to be underſtood by the *Word* in Queſtion; for ſeeing that ſome *Words*, belong to Notions, that are common to all Men; and other proper or peculiar to ſome that profeſs ſome certain *Diſciplines*: We are to mind, what Men are wont to underſtand by the *Word*; or what the *Maſters* of thoſe *Diſciplines* are uſed to ſignifie by them; or what he means by them, who makes uſe of them in *Writing* or in his *Speech*. For it cannot be doubted, but that the

moſt

most part of our disputes arise from the Ambiguity of *Words*; whilst one takes them in one Sense, another in another; which disputes might easily be decided, if the Parties in contest were agreed about the signification of the Word in question.

IV. *What is to be observed about things.* About the thing it self, we are to consider *what it is*, that is, what its Essence and Properties are. *Whether it be*, that is, whether it exist in the Nature of *Things*; and if it do, whether its existence be possible or necessary. *Whence it hath its Original*, whether *from it self*, or from some other *thing*; and if it proceed from another, whether by *Creation* or *Generation*. Of what Nature it is, *Material* or *Intellectual*, and with what Faculties it is endowed, &c. *Of what quantity*, or bigness it is, and what space it takes up amongst other *Bodies*, if it be *Material*; and what if it be *Intellectual*, what its *Powers* are. *What effects it produceth*, that is, whether it be a Principal Cause, or an Instrumental only; whether it work voluntarily or necessarily; whether it be Univocal, or Equivocal, &c. *How it is distinguished from other things*, or what distinction there is between it, and other things, and whether it differ from them really, or Notionally only.

V. *What a Question is.* *Analytical Method* being the Art which guides Reason in the Research of *Truth*, we must before all things, endeavour to know the Nature of the *Question*, which we are to examin, and to consider afterwards, how many sorts of *Questions* there may be made. *Questions* are *Propositions*, which include something that is already known, and something that is unknown. For otherwise, they would be rather known *Truths*, than *Truths* to be known; and if they did not also contain something that is known, they could not properly be called *Questions*, because we cannot proceed to that which is unknown, but by means of something that is known.

VI. *There is a four-fold way of searching out the Truth of things: First when by the Effects we find out the Cause.* All *Questions* concerning things may be reduced to four *Species*. First, When from the *Effects* we find out the *Cause*. As for Example it is Notorious, that the *Sun* shining upon a *Prism*, represents therein variety of *Colours*; the Question is, what is the true cause of so many divers *Effects*. It is a known thing, that *Air* and *Water* are subject to *Rarefaction*, and that at one time they take up more space than at another: the *Question is*, what is the reason of this change, and what there is in Nature, that can encrease the quantity of *Bodies*.

VII. *The second is when from the Causes we enquire into the Nature of the Effects.* The second *sort of Questions is*, when *Effects* are endeavoured to be discovered by their *Causes*. It is a known thing, that *Wind* and *Water* have great force in them, to move *Bodies*; but our *Fore-Fathers*, for want of due attention, not considering duly what *Effects* might be produced from those *Causes*, did not make that good use of them, as we now do, by the useful inventions of *Watermils* and *Windmils*, and many other conveniences, by which abundance of human labour is spared, which is an advantage of true *Natural Philosophy*. The first sort of *Questions*, in which the *Cause* is searched out by the *Effects*, are the total Object of *Natural Philosophy*; and the second sort, in which the *Effects* are enquired into by the *Cause*, are the whole *Practise* of it.

VIII. *Thirdly, when from the Parts we enquire into the Nature of the Whole.* The third *sort of Questions is*, when from the Parts we enquire into the Nature of the whole; as when after having set down several Numbers, by adding them together, we enquire, what Number results from them all. Or when having got two Numbers, we enquire, what they produce by mutual *Multiplication*.

IX. *Fourthly, when from one Part we search into the Nature of another.* The Fourth is, when having a whole, and some part of it, we search out the other part of it: As, when having a determinate number, and that part which is to be taken from it, we enquire, what number will afterwards remain to us. By the Word *Part* in this place, we are not strictly to understand, only the *Part* of a thing, but whatsoever doth belong to any *Substance*, such as are *Modes*, *Properties*, *Accidents*, and in a Word, all the *Attributes* that are found in any thing.

X. *What is required to enable us to answer these Questions.* That we may be able to answer these *Questions*, in the *First place*, it is requisite, that we clearly and distinctly conceive the point, that is precisely enquired after. Secondly, that we do not precipitate our Answer, till we have discovered whatsoever belongs to the *Question*, by certain *Signs* and *Tokens*, and not imitate those, who hearing their Friends Name, presently conceive it to signifie that particular *Person*, and give their answer, before they know what he, who asked the *Question*, means by it. Thirdly, Forasmuch as in every *Question*, there is something conccaled, we must be careful to denote that which is hid, by some certain *Conditions*, which may determine us to the seeking of one thing, rather than another, and which may induce us to judge, that that which we have found is the very same thing, that was enquired after. Fourthly, After we have examined the *Conditions*, let us set our selves seriously to consider, whatsoever in the matter propounded is either hid from us, or clear and evident to us; forasmuch as by means of this, we may arrive to that which is unknown to us. And in this our Attention to that which we know of a *thing*, in the resolving of a *Question*, *Analytical Method* chiefly consists: The whole Art and industry whereof consists in this, by this Examination to find out several *Truths*, which may lead us to the knowledge of that thing, which we are endeavouring to discover.

XI. *What Analytical Method is.* *Analytical Method* therefore is nothing else, but *a Particular application of the Mind, to that which is known, of that which is most particular in the Question to be resolved; whence it successively deduceth other Truths, which lead it at last, to the thing it desires to know.* I say, that *Analytical Method is a particular Application of the Mind, to that which is known*; to observe that which *Analytical Method*, hath in common with *Synthetical*, which also begins with that which is known. And add, *of that which is most particular in the Question it would resolve*. To intimate the difference that is between the *Analytical* and *Synthetical Method*; and that this latter takes that which is known, of that which is most general in the *Questions*; whereas the other takes it of that which is most particular in them.

XII. *How by way of Analysis we may prove the Mind of Man to be Immortal.* As suppose the *Question* to be *whether the Mind of Man be immortal*; and to find out this, we consider the Nature of the *Mind*, and presently discover, that Thinking is the property of the *Mind* of Man, which tho' it might be supposed to doubt of every thing besides, yet cannot doubt of its own Thinking, since its doubting is a kind of Thinking. Afterwards it proceeds to examin what it is to Think, and when it perceives that nothing is

included in its *Idea*, of what is involved in the *Idea* of an *Extended Subſtance*, or a *Body*: Yea, that it may be denied of *Cogitation*, that it belongs to the *Body*, foraſmuch as it is ſomething extended in *Length*, *Breadth*, and *Depth*, hath *Parts*, is of ſuch and ſuch a *Figure*, is *Diviſible*, *&c.* without deſtroying the Idea we have of *Cogitation*: We conclude, that *Cogitation* cannot be the Mode of an *Extended Subſtance*; becauſe the Nature of a *Mode* is ſuch that it cannot be conceived, when the thing whoſe *Mode* it is, is denied of it. Whence it may alſo be inferr'd, that ſeeing *Cogitation* is not a *Mode* of the *Body*, it muſt needs be the *Attribute* of another thing; and that therefore a *Thinking Subſtance*, and an *Extended Subſtance*, are two diſtinct Subſtances. From which finally we conclude, that the deſtruction of the one, doth not infer the deſtruction of the other. Add alſo, that *Extended Subſtance* cannot properly be ſaid to be deſtroyed, ſince whatſoever we may call its deſtruction, is nothing elſe but a change or diſſolution of ſome *parts* of the *Matter*, which ſtill remains the ſame in Nature as it was. As when all the *Wheels* of a *Watch* are broken, we may eaſily judge that no p rt of the *Watch* is deſtroyed, tho' the *Watch* it ſelf be commonly ſaid to be ſpoil'd or deſtroyed. From which *Example* it appears, that the *Soul*, which is not *diviſible*, neither conſiſts of any *parts*, cannot periſh, and conſequently that it is *Immortal*.

XIII. *Analytical Method proceeds from a heedful Conſideration of a thing.*

Whenſoever therefore the *Nature* or *Cauſe* of any thing is propoſed to our Examination, we muſt in the firſt place accurately examine all the Conditions of the *Queſtion* propounded, without minding ſuch as are *Extraneous*, and do not belong to the *Queſtion*. *Secondly*, We are to ſeparate thoſe things which are certain and manifeſt from thoſe that include any thing of *Confuſion* or *Doubt*: For we are to ſearch and trace out the thing we enquire for, from clear and evident *Idea's*. *Thirdly*, Every Difficulty we meet with is to be divided into Parts, which *Parts* are to be conſidered by themſelves. For *Partition* is like a *Torch* to a Learner, directing him which way he is to go, without uncertainly wandring up and down. *Fourthly*, We are orderly to diſpoſe of our *Perceptions*, and the *Judgments* we frame thence; ſo that beginning from the moſt eaſie, we may proceed by degrees to thoſe that are more difficult. Wherefore our chief buſineſs muſt be, diligently to conſider, and well to weigh thoſe Particulars chiefly, which are clear and perſpicuous in the *Queſtion*, and not proceed to thoſe that are unknown, except we find that by thoſe which are already known to us, we are likely to Maſter them. *Fifthly*, That the *Thing* in queſtion, be furniſh'd with ſome *Note* or other that may determine it, and make us judge it to be the ſame, whenever we meet with it.

XIV. *An Example of the aforeſaid Analytical Method.*

As by *Example*, it is apparent that *Water*, and all *Liquid things*, have their Parts in *Motion*: For we ſee that *Water* diſſolves *Salt* and *Sugar*. which would not be, if the inſenſible parts of the *Water* by their continual *motion*, did not run againſt the *Salt* and *Sugar*. And if we enquire into the Cauſe of this *Motion*, we ſhall find that *Water* and other *Liquid Bodies*, are not moved of themſelves, becauſe they are *Bodies*, ſince all *Bodies* are not moved. and thoſe which reſt are *Bodies* as well as thoſe which are moved. Wherefore we are to ſeek for a *Foreign Cauſe*, which produceth *Motion* in *Liquid Bodies*, and makes them to diſſolve the Particles of *Salt*. And finding that the *Air*, by penetrating the *Pores* of the *Water*, cannot be the Cauſe of this *Motion*; for whence ſhould the *Air* have the force to agitate all the parts of the *Water*? it remains that we aſſign ſome other Matter more ſubtil than *Air*, and more fluid, which may put the *Air*, *Water*, and other *Liquid Bodies* into *Motion*, which in the General Part of our *Natural Philoſophy* we ſhall declare to be the *Firſt Element*. For the more ſubtil any *Body* is, or divided into leſs Parts, ſo much the more eaſily it is agitated, and being once put into *Motion*, doth the more eaſily retain it. Wherefore the moſt *ſubtil Æther*, or *Celeſtial Matter*, muſt be ſuppoſed to be the *firſt Principle* of *Motion*, which *Matter abounds* in the *Fire*, *Sun*, *Fix'd Stars*, *Spirit of Wine*, and other Liquors.

XV. *In all Method we are to proceed from that which is more known, to that which is leſs known.*

Wherefore in the *Analytical*, as well as *Synthetical Method*, we are always to proceed from that which is more known, to that which is leſs known. This *Rule* is common to all *Method*, neither is any to be accounted true that deviates from this *Principle*. Yet there is this difference between the *Method of Reſolution*, and that of *Compoſition*; that in the former, the *Known Truths* uſed in the Examination of the thing, which is propounded to be known, are taken from *Particulars*, and from them we do (as by ſpecial Steps) aſcend to *Generals*; not as is done in the latter, where beginning with *Generals*, we come down to *Particulars*. So that theſe two *Methods* differ, as the *Aſcent* or *Deſcent* of the ſame *Hill*; or the *Way* whereby we go up from the *Valley* to the Top of the *Hill*, and again come down from thence to the *Valley*.

CHAP. XXII.

Of the Method of Compoſition.

I. *What uſe we are to make of the Synthetical Method.*

THis *Method* is called the *Method of* COMPOSING, becauſe it makes uſe of General and Common things, to come to things Particular and Compound: As for Example, If I have a mind to teach another by the way of *Synthetical Method*, that *the Soul of Man is Immortal*, I begin with theſe general *Maxims*; That Every *Being* is either a *Subſtance*, or a *Mode*; that there are two *Subſtances*, *viz.* a *Thinking Subſtance*, and an *Extended Subſtance*; that no *Subſtance* can properly be ſaid to periſh; that what we call Deſtruction in a *Bodily Subſtance*, is only a Diſſolution of its *Parts*: Whence I conclude, that that which hath no *Parts*, as the *Soul*, cannot be deſtroyed, and that by conſequence it is *Immortal*.

II. *Why Synthetical Method proceeds from things General, to leſs General.*

I have ſaid, that the *Method of Compounding* proceeds from more *Univerſal things*, to ſuch as are leſs *Univerſal*; and it does ſo, becauſe by this way of proceeding, all Repetitions, which commonly occaſion Confuſion and Tediouſneſs, may be avoided. For ſhould we treat of *Species*, before we have ſpoken of the *Genus*; foraſmuch as we cannot know the *Species*, without knowing the *Genus* firſt, we ſhould be fain to explain the Nature of the *Genus*, as often as we had occaſion to treat of any *Species*. But becauſe this way of Demonſtration is peculiar to *Geometricians*, and is look'd upon by them as very neceſſary to perſuade Truth, we will borrow from them whatſoever we have

have to say concerning it, to the end that we may follow the same way in searching out the *Knowledge* of other things, which they use in the demonstration of Matters *Geometrical.*

III. *What things Mathematicians make use of in their Demonstrations.*

Mathematicians are wont to deduce those things that are of the greatest moment and weight from known and easie *Principles*, by a Chain of Simple *Truths*; which they refer to three kinds; the first whereof includes *Definitions*: As, a *Right Line* is that which is the shortest betwixt two *Points*. A *Point* is that which hath no *Parts*. The second contains *Postulata*, or things demanded or taken for granted, which are so evident as to need no confirmation, and want nothing but the *Hearers assent*, *viz.* that from any *Center*, and at any distance, a *Circle* may be described. The Third comprehends *Axioms*, or common *Notions* of the Mind, which are not only manifest and evident in the *Science* we are treating of, but also in all others: As that all *Right Angles* are equal amongst themselves; that which is Equal, is bigger than all its Parts taken together.

IV. *Three things are required to the Extorting an Assent.*

Hence three things are chiefly observed by *Geometricians*, for the forcing of *Assent*. *First*, That *no Ambiguity be left in the Terms*, which is easily avoided by the *Definitions* of the *Terms*, which (as was said before) are nothing else but open Explications of the *Terms* and *Words* by which the things under debate are signified. The *Second* is, That every *Ratiocination be founded on clear and distinct Principles*, being so evident, that whosoever rightly understands the Words, must needs give his Assent to them. Which is the Reason why *Mathematicians* do always presuppose their *Axioms*, which they require to be granted them, as being so evident, that they stand in need of no Explication. The *Third* is, That *every Conclusion they propound be proved demonstratively*, making use only of those *Definitions* they have already alledged, or such *Principles* as have been granted them: Or lastly, *Propositions*, which by force of *Argument* they have deduced from them. So that all which *Mathematicians* observe concerning this matter, may be reduced to these *Heads*, which we shall comprehend in the following *Rules*.

Rules of Definitions.

V. First Rule of Definitions.

The First, *That every Obscure or Equivocal Term be defined.*

VI. Second Rule.

The Second, *That no Terms do enter the Definition, which are not altogether clear, or have not been before explained.*

Which two *Rules* are of that necessity, that they cannot sufficiently be imprinted in our Minds; forasmuch as by this means many *Disputations* are taken out of the way, which oft consists only in the *Ambiguity* of Words; as when the same *Term* is by divers Persons taken in a different Sense; which is a thing that happens very frequently in *Schools*. Wherefore, for the Removal of so many *Disputations*, which often do arise amongst the divers Sects of *Philosophers*, it will be sufficient if the Disputing Parties take care to explain distinctly, and in few words, what they conceive by the *Term* about which they Dispute, and what they would have others to understand by it. As for the *Qualifications* of the *Definitions* of things, of these we have treated in the Fourteenth *Chapter*.

The Rule of Axioms.

VII. A Rule for Axioms.

This is a Rule of *Axioms*, *That no Propositions be set up for Axioms, but such as are most manifest and evident.*

For no body questions, but that there are some Common Notions of the *Mind* that are so clear and perspicuous, as to stand in need of no *Demonstration*, to make them appear more distinctly. For did they involve the least Doubtfulness, they could not be the Foundation of a certain *Conclusion*. And therefore they are called *Axioms*, or common *Enunciations*, because they are so clear and manifest, as to stand in need of no Demonstration.

VIII. *The Evidence of Axioms doth not arise from the Senses.*

But we are not to suppose, as some do, that the *Certainty* and *Evidence* of *Propositions* doth in any degree proceed from the *Senses*; for that is absolutely false. For the *Truth-discerning-Faculty* is not placed in the *Senses*, which are often deceived by a *Similitude* of Things, and are not able to dive into the Difference that lies hid in them. Who is it that doth not experience how narrow and weak our *Senses* are, and how frequently they deceive us, when we go about to search out any thing by their means?

For altho' this *Axiom*, That *the Whole is greater than any one of its Parts*, be in some sort discernible by the *Senses*, yet not with such a *Certainty* as is necessary to *Science*; because whatsoever our *Senses* discover to us concerning it, is only founded on the observations of our *Infancy*, which cannot afford us an undoubted, but only a probable *Certainty*. For by *Induction* a thing cannot be certainly known, except we be certain of the fulness of the *Induction*; there being nothing more common, than for us to discern at last the falsity of those things, which from general *Inductions* we were persuaded to be most True. The whole Truth of this Proposition, *the Whole is bigger than its Parts*, doth depend on the clear and distinct *Notions* we have of the Whole and Parts, by which we judge that the *Whole* is greater than any one of its *Parts*, and that the *Part* is less than the *Whole*. For when we are discoursing of any thing that is firm and stable, we must not have recourse to the *Senses*, as *Plato* saith; but to constant, immutable, and impregnable *Reasons*. Thus we clearly know, that a *Triangle* is a *Figure*, that the Number *Two* is an even Number; because the Notion of a *Figure* is contained in the Definition of a *Triangle*; and in that of the Number *Two*, the Notion of an *Even Number*.

IX. *The Certainty of Propositions depends on the clear Knowledge we have of them.*

Wherefore all the Certainty of our Knowledge in *Natural things*, depends on this Principle, *Whatsoever is included in the clear and distinct Idea of any thing, the same may with truth be affirmed of it.* Thus because *Substance* is included in the Conception of a *Body*, we may affirm a *Body* to be a *Substance*. *Because it is involved in the Idea of a Circle, to have equal Diameters*, we may assert of every Circle, *That all their Diameters are Equal. Because it is included in the Idea of a Triangle, that all its Angles are Equal to two Right ones, we may affirm the same of all Triangles.* What must be the *Qualifications* of *Axioms*, appears from what we have said of the framing of *Propositions* that are necessarily true, in the Thirteenth *Chapter*.

Most

Moſt General Axioms.

X. *To have many* Axioms *in a readineſs, is a great help to ready Arguing or Ratiocination.*

But foraſmuch as it is of great uſe, to have good ſtore of *Axioms* at hand, whereby to prove and diſcover what is obſcure and abſtruſe; it will be neceſſary to ſet down here ſome general and neceſſary *Propoſitions*, from which as ſo many *Fountains*, more ſpecial ones as *Rivulets* may be derived.

I. *Whatſoever is comprehended in the clear and diſtinct Conception of any thing, the ſame may with Truth be affirmed of it.*

For ſince in the clear and diſtinct *Conception* of a *Body Extenſion* is contained, and *Cogitation* in the *Idea* of the *Soul*, I can truly affirm of a *Body* that it is extended; and of the *Soul*, that it is a *Thinking Subſtance*. Wherefore we are to lay down this, as the Foundation of all *Sciences*; that we muſt never give our full aſſent to any *Propoſition*, which doth not appear evidently true to us, ſo as that we cannot but aſſent to it, without doing violence to our *Minds*.

II. *In every Idea or Conception is involved either Poſſible or neceſſary Exiſtence.*

Since nothing can be apprehended by us, except under the notion of being *Exiſtent*; that is, neceſſary *Exiſtence* is comprehended in the notion of a *Being* abſolutely perfect, that is, of *God*; and poſſible *Exiſtence* in that of a *Creature*, or of a limited and finite *Being*.

III. *Nothing has no Affections or Properties.*

So it cannot be ſaid, that nothing is Diviſible, that it hath *Parts*, that it can be moved, &c. Wherefore, whereſoever any Property is found, there we may aſſert that there is a *True* and *Real Being*.

IV. *Nothing cannot be the Cauſe of any Thing.*

Foraſmuch as the Cauſe of a *Thing* is ſuppoſed to be, before it can produce any *thing*, and that Nothing cannot exiſt, it doth follow, that neither can it be *Principle* or *cauſe* of any *thing*. For if *Nothing* could ever be Something, it would follow, in oppoſition to the foregoing *Maxim*, that it muſt have ſome Property, which is a Contradiction.

From this *Axiom*, ſome others are deduced by way of *Corollaries*; ſuch as are,

V. *Nothing, nor any Perfection of a thing, actually Exiſtent, can have Nothing, or a thing not Exiſting, for the cauſe of its Exiſtence.*

Another *Corollary*:

VI. *Whatſoever Reality, or Perfection there is in any thing, the ſame is formally, or eminently in the firſt, and adequate cauſe of that thing.*

Whence it follows, that the *Objective Reality* of our *Idea's*, requires a Cauſe in which the ſame *Reality*, is contained, not only *Objectively*, but Formally, or Eminently. For this *Axiom* doth not only belong to the *Efficient Cauſe*, but alſo to the *Exemplary*. For if an *Image* be made more excellent than its *Exemplar* or *Original*, ſo that more Perfections are found in it, than in the thing it ſelf, after the likeneſs of which it is made, it cannot be ſaid to imitate its Exemplar, and conſequently cannot properly be called its *Image*.

VII. *A Thing or Subſtance, cannot naturally be Annihilated.*

That is, it cannot ſo ceaſe to be, as that nothing at all ſhould remain of it. For we eaſily conceive, that when any thing ceaſeth to appear, it doth chage its *Nature*, or is converted into another thing; As for Example, we can well enough conceive, how *Wood* comes to ceaſe to be *Wood*, how it comes to be *Fire*, and how the ſeveral *Particles* of *Fire* are ſubdivided into others, that at laſt they cannot be perceived by any *Senſe*: But we can by no means conceive, how they ſhould be reduced naturally to nothing, and from *Being* paſs, to not *Being*.

VIII. *That which is clear and evident is not to be denied, becauſe that which is obſcure, cannot be comprehended.*

For we cannot doubt, but that there is Liberty and Indifferency in us, becauſe we are conſcious of it, and comprehend nothing more evidently or perfectly, tho' we cannot comprehend, how *God* doth leave the free actions of Men indetermined.

IX. *It is the nature of a Finite Mind, to be unable to comprehend that which is infinite.*

Becauſe it is the nature of an *Infinite being*, to be Incomprehenſible; for if it could be comprehended, it would not be Infinite. What wonder is it therefore, that we cannot conceive matter to be Diviſible into Infinite? Or that we cannot underſtand the *Myſtery* of the *Trinity*, or the *Incarnation* of the *Divine Word*? Becauſe our *Mind* is *Finite*, and bears no propotion to the *Myſteries*. Would but ſome Men weigh this *Axiom*, as they ought, they would not with ſo much obſtinacy, rely upon their weak Reaſon, or truſting to their own Wits, invent a new kind of *Divinity*.

X. *If you take Equals from Equals, what remains will be Equal.*

XI. *If you add Equals to Equals, the whole will be Equal.*

XII. *It is in vain to endeavour that by more, which can commodiouſly be performed by leſs.*

Special Logical Axioms.

Logical Axioms are of great uſe.

To theſe we may ſubjoyn ſome *Logical Axioms*, which are of great uſe, in the guiding of our *Diſcourſe*, and are taken from the *Genus, Species, Difference, Diviſion, Cauſes, &c.*

From the Genus.

I. *Whatſoever is affirmed or denied of the* Genus, *the ſame is affirmed or denied of the* Species.

The reaſon is, becauſe the *Genus* contains the *Species*, and becauſe the whole *Eſſence* of the *Genus* is found in them: Thus, becauſe it is affirmed of an *Animal*, that it is *Senſitive*, the ſame is alſo affirmed of *Man* and *Beaſt*. And becauſe the ſame *Animal* is denied to be a *Stone*, ſo likewiſe, the ſame is denied of a *Man* and a *Beaſt*. Wherefore, the *Genus* is of no uſe to prove the *Species*, but only to remove it. For that which is not an *Animal*, neither can it be a *Man*; but that which is a *Man*, muſt therefore be an *Animal*.

II. *The ſuppoſing of the* Genus, *doth not ſuppoſe ſuch a* Species.

As for Example, ſuppoſing any thing to be an *Animal*, it cannot from thence be concluded, that it is a *Man*; becauſe it may be a *Beaſt*, which is likewiſe an *Animal*.

III. *The* Genus *being deſtroyed, the* Species *muſt be deſtroyed with it.*

For ſeeing that the *Genus* is an eſſential part of the *Species*, it muſt follow that the *Genus* being deſtroyed, that muſt needs be deſtroyed with it, which conſiſts of *it*. Thus if we take away an *Animal*,

Animal, we together take away the *Species*, that are contained under it. And by taking away a *Foursquare Figure*, we at the same time take away a *Parallelogram* and a *Trapezium*, which are the *Species* of a *Foursquare*.

From the Species.

I. *The supposing of the* Species, *supposeth the* Genus; *but the taking away of one* Species, *doth not necessarily remove the* Genus.

Because the *Idea* of the *Genus*, is comprehended in the *Essential Conception* of the *Species*, without which the nature of the *Species* cannot be explained. So supposing a *Binary* or the number two, we suppose a *number* also; and asserting a *Parallelogram*, we likewise assert a *Square*. And if all *Beasts* were taken out the *World*, yet would not *Animal* be therefore taken away, seeing it would be preserved in *Man*. Hence it is, that the *Species* is of great force to prove the *Genus*, but of none at all to deny it. For that which is a *Binary*, must be a *number*, but it does not follow, that that which is no *Binary*, is therefore no *number*.

II. *All the* Species *being destroyed, the* Genus *is destroyed likewise.*

For in this case all the power of the *Genus* is exhausted, neither doth there any thing remain, of which it can be affirmed. So supposing the *Sight*, *Hearing*, *Tasting*, *Smelling* and *Feeling* to be destroyed; the outward *Sense* must be destroyed likewise: And taking away *Prudence*, *Justice*, *Temperance* and *Fortitude*, takes away *Vertue* also.

From the Form or Difference.

I. *The Form is that by which a thing is, what it is.*

Because the *Form* or *Difference*, is the chief *Essential Attribute* that is found in the *Species*, and whose property it is to constitute the same, and distinguish it from other *Species*. Thus *Extension* constitutes a *Body*, and *Cogitation* the *Mind* or *Soul* of *Man*.

II. *Where the total Difference or Form can be affirmed or denied, of the same the* Species *also may be affirmed or denied.*

This *Axiom* as a *Corollary* is deduced from the former; for seeing the thing is constituted by the difference, where the same is found, it is necessary that there the *Species* be also. Thus, because *Cogitation* may be affirmed of the *Mind* of *Man*, therefore we may affirm it to be a *Thinking Being*.

III. *The Form and* Species *are reciprocated.*

The *Reason* is, because *Difference* constitutes the *Species*, and doth distinguish it from other *Species*, and therefore must have the same latitude as the *Species* it self, and therefore must reciprocally be affirmed of one another: As, *Every thing that Thinks is a* Mind, *and every thing that is a* Mind *Thinks.*

From the Property.

I. *The Property is consequent on the Form.*

For the *Property* is something flowing from the nature of the *Species*, and so bound to it, that it agrees to the whole *Species*: So *Divisibility* follows *Extension*, and is so necessarily joyned to it, that no Body can be extended, but that it must be Divisible also.

II. *The supposing of the Form, supposeth the Property, and the taking away of it, takes away the Property also.*

As when *Extension* is supposed, *Impenetrability* and *Divisibility* are supposed likewise; and if that be taken away, the *Properties* are taken away also.

From the Definition.

I. *Whatsoever agrees with the Definition, agrees also with the thing Defined.*

For seeing that a *Definition* declares the nature of a thing, by its *Essential Attributes*, *viz.* by its *Genus* and *Difference*, it must include the Whole, contained in the thing defined; and therefore whatsoever is *Attributed* to the *Definition*, the same must necessarily be also *Attributed* to the *thing defined*. Thus, because it agrees to the *Art of Discoursing well*, to direct the *Mind*; therefore also it must agree to *Logick*, to direct the *Mind*.

II. *If the Definition belong to a thing, the thing defined must also belong to it.*

Thus, because it belongs to the *Mind* of *Man*, to be a *Thinking Substance*, it belongs also to the same to be a *Spirit*. And because to a *Stone*, belongs Extension in Length, Breadth and Depth, therefore it also belongs to it, to be a *Body*.

III. *If a Definition agree with a Definition, the thing Defined also, must agree with the thing Defined.*

As, That which consists of a *Body* and *Mind*, is endowed with *Sense*; therefore *Man* is an *Animal*. *Substance* is something which hath an *Essence* and *Existence* distinguisht from all other *things*; and on the contrary.

From Division.

I. *If no part of the Division agrees to a thing, neither doth the thing divided agree with it.*

Thus, because the notion neither of a *Spirit* nor *Body*, doth agree to *Substantial Forms* (save only the *Soul* of *Man*.) Therefore, *Substantial Forms* cannot be *Substances*.

II. *Every Division must be entire, that is, it Enumerates all and every Part belonging to a thing.*

For should any part belonging to a thing, be omitted in the *Division*, there could not be an Adequate Enumeration of the *Parts*, neither consequently would the thing, by means of such a *Division*, be distinctly perceived. Thus the *Division* of a *Man* into *Sound* and *Sick*, is not Adequate, because there is a kind of Middle State, as, is that of a *Man*, that is recovering from *Sickness*. But the *Division* of *Hand* into *Right* and *Left*; of a Line into *Right* and *Crooked*; of a *Number* into *Even* and *Odd*, is Adequate because it Enumerates all and every *Part*.

III. *The Parts of a Division must be opposit.*

This Axiom follows from the foregoing. Thus things are better divided into *Material* and *Immaterial*, than into *Visible* and *Invisible*; because some *Invisible things*, as a very clear *Air*, and our *Breath*, are not by nature distinct from *Visibles*.

From the Cause.

I. *The Cause is always before the Effects*

For seeing the *Cause* is that from which a thing hath its Original, or that of which that *Being* doth in some sort depend, therefore it must needs exist before it. So a *Carpenter* is before the *Building*; A *Father* before the *Son*, *&c.* A *Cause* is in a twofold Sense said to be before its Effect, *viz.* by a Priority of *Nature* and *Time*. A *Cause* is before

its *Effect* by a Priority of *Nature*; becauſe the *Effect* exiſts by the Power of the *Cauſe*, and not the *Cauſe* by the power and virtue of the *Effect*; yet not always by priority of *Time*, becauſe ſome *Effects* exiſt at the ſame time with their *Cauſes*, as all thoſe *Effects* which proceed by Emanation; as the *Proprieties* do from their *Subjects*, which therefore exiſt the ſame moment with them.

II. *Nothing can be a Cauſe of it ſelf.*

For ſeeing there is a Dependance in the *Effect*, whereby it proceeds from ſomething that was before it; it cannot be conceived, how any thing ſhould be prior to it ſelf.

III. *Suppoſing the Cauſe in Act, we ſuppoſe the Effect in Act alſo.*

The Reaſon is, becauſe when the *Cauſe* is conſtituted in *Act*, it always does ſomething, and that which it does is called its *Effect*. As ſuppoſing *God* a Producer, we muſt neceſſarily ſuppoſe ſomething produced; and therefore the Cauſe and its Effect, as well as other Relates, are ſaid to be *ſimul Natura*, that is, to be both at once; for no ſooner is one *Relative* named, but at the ſame time we underſtand the other. So he is a *Father*, who hath a *Son*; and he a *Son*, who hath a *Father*.

IV. *A Cauſe cannot give that which it hath not.*

For a *Cauſe* gives ſomething to another thing, but it cannot give that which it ſelf wants.

V. *Whoſoever Acts by another, is eſteemed to act of himſelf.*

As he who deſires, exhorts, and adviſeth others to commit ſome Wickedneſs, is ſaid to be the *Moral Cauſe*; becauſe by Deſiring or Commanding, &c. He makes the Effect to be imputed to him.

From the Effect.

I. *The Effect is poſterior to its Cauſe.*

This *Axiom* follows from the foregoing: For if the *Cauſe* be before the *Effect*, it follows that the *Effect* muſt preſuppoſe it.

II. *No Effect exceeds the virtue of its Cauſe.*

For ſeeing the *Effect* borrows its Being from the *Cauſe*, it is impoſſible it ſhould take any thing that goes beyond or exceeds the Power of its *Cauſe*. For *Fire* would never be able to warm the *Hand*, if *to warm* did exceed the virtue of *Fire*.

III. *That becauſe of which every thing is ſuch, is it ſelf more ſuch.*

That is, if the Nature of the *Effect* be good or bad; the ſame doth more clearly appear in the *Cauſe*. This is true when both are capable of the ſame *Quality*: Thus becauſe the *Kettle* is hot becauſe of the *Fire*, the *Fire* muſt needs be more hot. But we cannot argue, a *Man* is ſatiated with the *Meat* he eats, therefore the *Meat* is more ſatiated.

From the Subjects, and Adjuncts.

I. *Where the Subject is, there are the Adjuncts alſo.*

For ſeeing that the *Adjunct* is the Mode of the *Subject*, it does always accompany the ſame: As where the *Fire* is, there is *heat*; where a *Dead Carkaſs* is, there is a *ſtink*.

II. *Such as the Subject is, ſuch are the Adjuncts.*

For ſuch as the *Orator* is, ſuch is his power in Perſuading; as the *Sick* is, ſuch are his *ſymptoms*.

III. *Where the Adjuncts are, there is the Subject.*

Becauſe *Adjuncts* are added to the *Subject*, and are conſidered as things that belong to it. As where *Motion*, *Magnitude*, *&c.* is found, there muſt alſo be a *Body*.

From the Whole.

I. *What agrees to a Similar Whole, agrees alſo to the Parts of it.*

For ſeeing that a *Similar Whole* is made up of a Conjunction of *Similar Parts*, it muſt needs be of the ſame Nature with them. Thus, becauſe *Lead* is heavier than *Braſs*; therefore every part of *Lead*, proportion being obſerved, muſt be heavier than *Braſs*.

II. *Where any Whole is, there are all its Principal Parts.*

For the Principal Parts are Eſſential to the Whole. I ſay, the *Principal Parts*, as the *Head*, and the like; becauſe there are ſome Parts which belong to the *Entireneſs*, but not to the *Eſſence* of the thing.

III. *The Entire Whole being ſuppoſed, all its Parts are ſuppoſed alſo.*

The Reaſon is, becauſe this *Whole* is nothing elſe than the *Parts* taken all together: As where the *Entire Body* of *Man* is, there muſt be its *Skin*, *Bones*, *Sinews*, *Veins*, *Fleſh*, and all things that belong to the Entireneſs of it.

From the Parts.

I. *Every Part, with reſpect to its Whole, is Imperfect, and Incompleat.*

So the *Soul* and *Body*, with reſpect to a *Man*, are Imperfect and Incompleat; becauſe they both belong to make a Perfect *Man*. So the *Hands*, *Feet*, *Head*, which are the *Integral Parts* of Mans Body, are more Imperfect than the Whole Body.

II. *Where all the Parts are, and joyned together, there is the Whole.*

This *Axiom* is evident from what hath been already ſaid.

From Like and Unlike.

I. *Like do agree with Like.*

A *Prince* muſt govern a *Commonwealth* after the ſame manner, as a *Father* of a *Family* takes care of his *Family*.

II. *To Unlike things, Oppoſits do agree.*

As we love an *Honeſt man*, ſo we hate a *Wicked perſon*. A *Shepherd* feeds his *Sheep*, an *Hireling* neglects them.

From Relates.

I. *Relates are by Nature together, or at one and the ſame time.*

For ſeeing that every *Relation* is mutual, and one *Relative* reſpects the other; it cannot be, but that if you put the *Relate*, you muſt put the *Correlate* likewiſe: And therefore the *Cauſe* and the *Effect*, that which is before, and that which is after, and all other things that do mutually reſpect each other, are always at once and together in the *Mind*. From whence follows alſo this *Axiom*.

II. *One Relative being put, the other is put alſo; and being taken away, the other is ſo likewiſe.*

From

From Contraries.

I. *That which is ſuſceptive of one Contrary, is alſo ſuſceptive of the other.*

As *Water* can be made *hot*, therefore it may alſo be made *cold*. A *Dog* cannot act juſtly, and therefore neither unjuſtly.

II. *Of Contraries, it is neceſſary that the one be in the Subject ſuſceptive of it; the other not.*

Thus if a *Number* be not Even, it muſt be Uneven. Yet this *Axiom* doth not hold in all *Contraries*; for it is not neceſſary that a *Wall* ſhould be *white*, becauſe it is not *black*.

From Privative Oppoſits.

I. *If the one be Abſent, the other muſt be abſent alſo.*

This muſt be underſtood in a Capable Subject. As if a Man *ſees*, he is not *blind*. It is *Light*, therefore not *Dark*.

II. *For the Moſt part, there is no going back from a Privation to a Habit.*

As from *Death* to *Life*, from *Blindneſs* to *Sight*.

III. *What in one Subject is Privation, is often a Negation with regard to another.*

This appears in our *Errors*, which with reference to *God*, who doth not beſtow upon us the whole knowledge of *Truth*, are only called *Negations*; but with reference to us are *Defects* and *Privations*. Thus Ignorance of the *Laws* is blame-worthy in him, who profeſſeth skill in *Law*; but not to him who is of another Profeſſion.

From Contradictories.

I. *One Contradictory being put, the other is removed; and on the contrary.*

As ſuppoſing that *Peter walks*, it cannot be that he ſhould not *walk*.

From Parity, or Equality.

I. *Even things with Even things agree, or diſagree.*

As *Faith* to the *Patriarchs* was neceſſary to Salvation; therefore to us alſo.

From the Greater.

I. *If that which is more Likely is not; much leſs that which is leſs Likely.*

As if a *Woman* could not be tempted to *Sin* by an hundred *Guinea's*, much leſs by thirty.

From the Leſſer.

I. *If that which is leſs Likely is, much more that which is more likely.*

As, a Man hath kill'd the *King*, therefore he will make no difficulty of killing one of his Fellow-*Citizens*.

From Divine Authority.

I. *The Teſtimony of a Being Sovereignly Intelligent, Wiſe, and True, is of greater efficacy to perſuade, than any other the moſt ſtrong and evident Reaſons that may be.*

Thus ſince *God* tells us, that they are *bleſſed who are perſecuted for Righteouſneſs ſake*, we are to hold it for an undoubted *Truth*; becauſe we have a greater Certainty, that he who is Sovereignly Intelligent, and Infinitely Good, cannot be deceived, than we can be certain that we our ſelves are not deceived, even in thoſe things that appear moſt clear and evident to us. For we are to give credit to the *Divine Teſtimony*, not becauſe of the *Affirmation* or *Negation*, but for the Authority of the *Witneſs*, as being *Omnipotent*, *Omniſcient*, and of the moſt *Sovereign Veracity* and *Truth*.

From Human Authority.

I. *We ought not to oppoſe that which is owned by all Men, or moſt Men, or wiſe Men, or by the moſt Famous and moſt Approved of them.*

As for Example, it is a *Truth* received by the common conſent of all Men; that *we ought to venture our Lives for the welfare and ſafety of our Native Country*: And that it is the Duty of every Man, *to live honeſtly, to hurt no body, and to give to every Man his Right*. For this unanimous Agreement of all Men ſhews, that their *Judgment* in theſe Caſes proceeds from common inborn *Notions*, and not from any Compact to impoſe upon others, or deceive themſelves.

But yet we muſt not have the ſame Opinion of thoſe Men, who being over-credulous, deceive others, by reporting *Prodigies* which they had from others; as that there are *Sciopodes*, Men that have but one Foot, and that ſo great, that lying on their Backs they can ſhade their whole *Body* with it; or that there are Men that have ſo great Ears, that they reach down to their *Feet*, and ſo broad that they can lye upon them; and others again that have no *Heads*, and have their *Eyes* about their *Shoulders*: Becauſe we are not to believe every one, but only thoſe whoſe ſufficient knowledge of the Matters they relate, and Veracity, are fully known to us.

Two Rules of Demonſtrations.

I. *All Propoſitions that involve any thing of Obſcurity, are to be proved without alledging any thing in proof of them, beſides Definitions* which have gone before, or *Axioms* that have already been granted, or *Propoſitions* before demonſtrated, or the *Conſtruction of the thing in diſcourſe*, when any Operation is to be done.

II. *We are never to make an ill uſe of the Equivocation of Terms.* This may be occaſioned by not adding their *Definitions*, to reſtrain or explain them. For to every true *Demonſtration* two things eſpecially are required. *Firſt*, That in the *Matter* it ſelf nothing be contained, but what is certain and indubitable: The *Other*, That there be no fault in the Form of *Argumentation*: Which Faults we ſhall avoid by the Rules now given, that is, by not making an ill uſe of *Equivocal Terms*, and by uſing no other *Propoſitions* in our *Demonſtrations*, but what are either *Definitions* of *Terms* before explained, or *Axioms* that have been before granted, and which ought not to have been ſuppoſed, without being ſure of their Evidence; or *Propoſitions*, that have been before demonſtrated; or the *Conſtruction of the Thing* of which we treat, when any operation is to be performed. For by obſerving of theſe things all Defects or Miſtakes will be eaſily avoided both in Matter and Form.

As to the Conſtitution of *Demonſtrations*, we have handled it in the Nineteenth *Chapter* of the Third *Part*.

CHAP. XXIII.

Of Genetical Method.

I. *Themes are two-fold, Simple or Conjunct,*

HAving largly enough, as I suppose, spoken of *Method in general*, and of *Analytical* and *Synthetical* in particular, it may now be fitting to subjoyn something concerning *Genetical Method*, because it is of use, and belongs to the true Practice, or Exercise of *Logick*. *Genetical Method*, teacheth us to frame a *Discourse* upon any *Theme*, and takes it Name from *Genesis*, because it is as it were a new *Generation* of a *Thing*, and that whereby we Elaborate a *Theme*, that hath not as yet been Explained, or Demonstrated. And for as much as the *Theme*, or Matter proposed to be known, is either *One* and *Simple*, or *Conjunct* and *Complex*; as when for Example, I consider *God*, or the Power of *God*, in Creating the *World*, I consider something that is *Simple* or *Incomplex:* But when I set before me this Sentence, *God Created the World* (or any other Proposition, whereby any thing is affirmed or denied of another) I think of something that is *Conjunct* or *Complex*.

II. *How we are to handle a Simple Theme.*

The handling of a *Simple Theme*, consists in the seeking of *Arguments*, that may declare a *Simple Theme*, and the disposing of them in a due order. *Arguments* shew us the manner of inventing the *Definitions* of *Single Terms*, such as are the *Cause* and *Effect*, *Genus* and *Species*, the *whole* and its *Parts*, *Subject* and *Adjunct*, *Opposits*, *Divers*, *&c.* As for Example, if any one seeks for the *Efficient Cause* of *Man*, he must have recourse to the *Definition* of the *Efficient Cause*, which is, *that from which a thing by true Causality doth proceed:* Which *Definition* of the *Efficient Cause*, if it be referred to *Man*, presently, either *God* will be brought to his *Mind*, by whom he was Created presently after the *Beginning* of the *World*; Or his *Parents*, by whom all other *Men* since have been produced. And after the same manner he may find out the Matter of which he is made, the Form by which he is distinguisht from all other things; and the End for which he was *Created* by *God*.

III. *How the Effects are shewed.*

So likewise the *Effects* of *Man* are manifested by examining the *Works* that proceed from *Man*, as the *Efficient Cause*, *&c.* and in like manner handle the rest, as far as the *Theme* propounded will bear: For it is evident, that all *Themes* will not admit the same *Arguments*; seeing *God*, for Example, hath neither any *Efficient Cause*, nor *Form*, nor *Matter*, and therefore the same cannot be considered of in him. The same may be said of the *Angels*, and the *Mind* of *Man*, which have neither *Matter*, nor *Form*, nor consist of any *Parts*.

IV. *In a Simple Theme we are to examin the Word.*

In the handling of a *Simple Theme*, this order is commonly observed, as far as the nature of *Argument* will permit: *First*, To examin the *Word* of the *Theme*, whether it be derived, and if so, to give its *Etymology: Secondly*, Whether it be Ambiguous, and then its various *Significations* are to be Enumerated and expounded. *Thirdly*, Whether it be *Abstract* or *Concrete*.

V. *The* Genus.

In the Second Place, we must enquire into the *Genus*, from the *Predicamental Table* set down in the *First part*, Chap. V. which represents all the *Genera* and *Species*, which conduceth much to the knowledge of the *Theme*, forasmuch as the manner of handling *Themes* varieth according to the Diversity of the *Genera*.

VI. *The* Causes.

Thirdly, We must enquire into the *Causes*, which we have set down and Enumerated, *First part*, Chap. IX.

VII. Effects.

Fourthly, The *Effects* are to be considered; not every one, but such as are Memorable, and *worth* the Mentioning.

VIII. Adjuncts.

Fifthly, The *Adjuncts* are to be handled according as the *Theme* is, whether *Universal* or *Proper*; as also the *Antecedents* and *Consequents*.

IX. Definition.

In the Sixth Place, *Definition*, which, as soon as we have have found out the *Genus* and *Difference*, doth present it self unto us.

X. Division.

Next comes DIVSION, whereby the *Subject* is divided into its *Integral Parts*, if the *Theme* be an *Integral Whole*; or into *Species*, if it be a *Genus*.

XI. Comparates.

In the Eighth Place, COMPARATES, or *Things* that agree in *Quantity* or *Quality*.

XII. Opposits.

Lastly, OPPOSITS, are subjoyned to all these, and are of considerable *use*, according to that common Saying, *Contraries set together, Illustrate each other*.

XIII. *How a Conjunct Theme is to be demonstrated.*

A *Complex Theme*, or *Proposition* is *Genetically* Demonstrated from the *Subject* and *Predicat*, which as two *Integral Parts* do constitute the same. Because by them we judge, whether a *Proposition* be *True* or *False*, *Universal* or *Particular*, *Necessary* or *Contingent*, *Affirmative* or *Negative*. As suppose this *Conjunct Theme* be to be proved, *Man is Created after the Image of God*, we are to consider both the Parts, *viz.* the *Subject Man*, and the *Predicat*, the *Image* of *God*, after which *Man* is said to be *Created:* Next the *Quantity* and *Quality* of the *Proposition* are to be Examined: And Lastly, The *Reasons* or *Arguments* of the *Affirmation* are to be investigated from the nature of the *Subject* and *Predicat*.

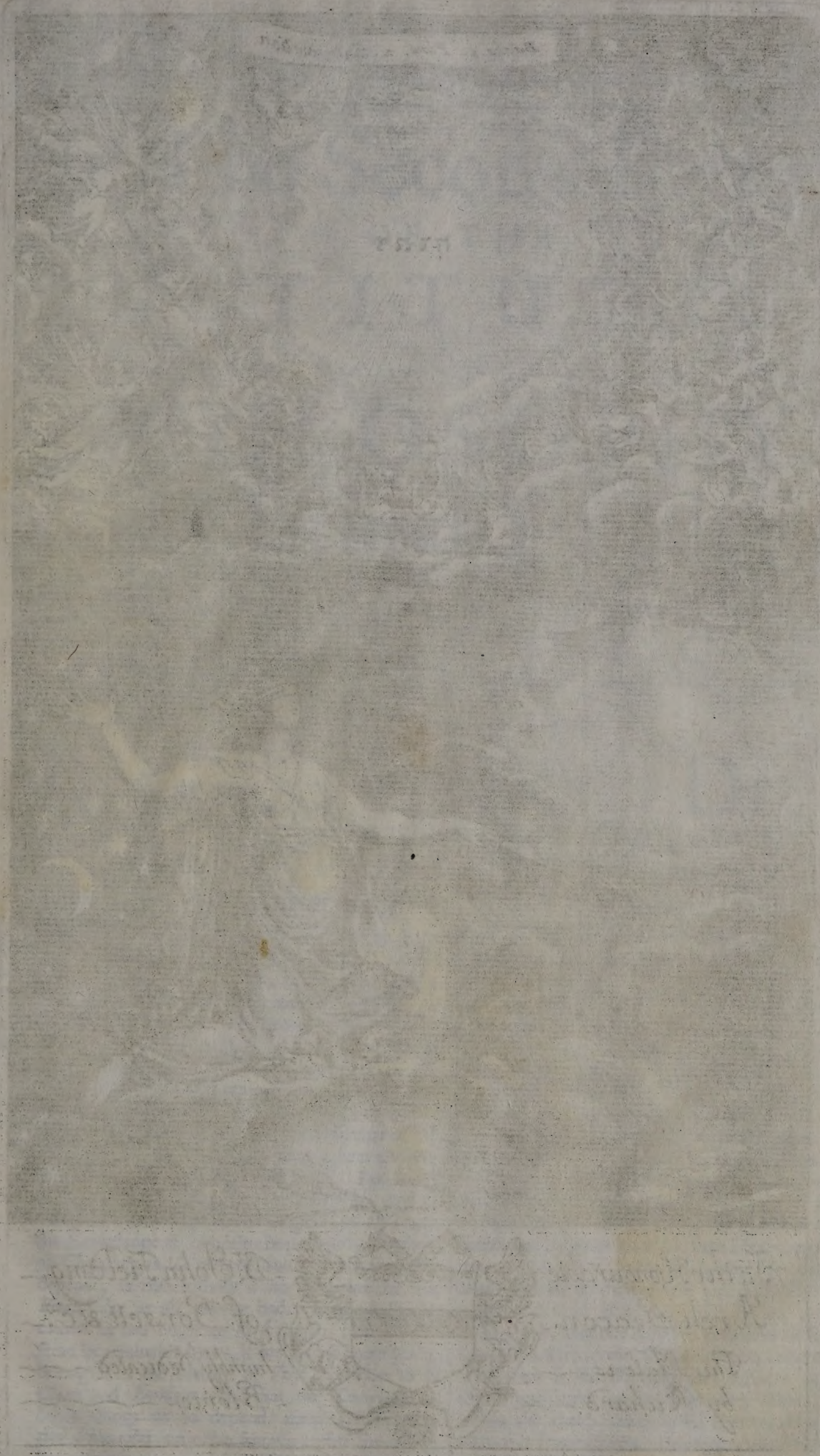
XIV. *How the Subject is to be considered.*

The *Subject Man* furnisheth us with *Reasons* or *Arguments*. First, From the *Efficient Cause*, because the *Holy Trinity* entred as it were into Consultation about the *Creating* of *Man*, which was not done in the other *VVorks* of the *Creation*, which is an *Argument* of a peculiar *Prerogative* of *Man*, before other *Creatures*, which consists in that he is an *Image of God*. Secondly, From his *Matter*, because he is made with a *Face*, directed towards *Heaven*, *&c.* Thirdly, From his *Form*, because he only of all sublunary *Creatures*, had a *Mind* breathed into him. Fourthly, From Singular *Effects*, which are the Evidences of a peculiar *Virtue* bestowed upon him. Fifthly, From his *Adjuncts*, because he excells all other *Creatures*, by the Power he has of *Understanding*, and determining himself. Sixthly, From his *Definition*, because he is a *Substance* consisting of *Mind* and *Matter*. Seventhly, From the *Place* of *Comparats*, because he comes near to the nature of the *Angels*; and Ninethly, From that of *Oppositis*, because he is not a *Beast*, devoid of *Reason*.

XV. *How the Predicat is to be considered.*

The *Predicat*, *made after the Image of God*, doth also afford us *Arguments* taken from the *Nature* of the *Divine Image*; *viz.* from its *Formal Reason*, or from its *Effects*, *Adjuncts*, *Parts*, *Definitions*, *Comparats*, *Contraries*, *&c.* which *Theology* handles at large.

THE



To the Honourable
Arch-Deacon
This Plate is
by Richard

B^r. John Fielding
of Dorsett &c^a.
humbly Dedicated
Blome

The Second Part
OF THE
INSTITUTION
OF
PHILOSOPHY.
Viz. Natural Theology,
OR, A
TREATISE
CONCERNING
GOD.

An Introductory Discourse
Of the Definition of Natural Theology, and its Certainty.

I. *Why* Natural Theology *is set before the other parts of* Philosophy.

SOME, it may be, will find it strange that I have given NATURAL THEOLOGY the precedence before other Parts of *Philosophy*, and that I betake my self to the demonstration of the *Existence* of GOD, and of his *Perfections*, before I have handled the Nature of *Corporeal Things*. But their Wonder will cease, if they consider how necessary *Natural Theology* is to other *Disciplines*, and of how great concern the knowledge of the *Divine Existence* is, for attaining a firm and evident *Knowledge* of all other Things. For seeing that GOD is the *Author* of the *World*, and all things that are in it, and the *Original* of all *Truth*, the Knowledge of him is to be premised, of whom all Certainty and Truth of *Science* doth so closely depend, as that without it no *Evidence* or true *Knowledge* at all can be had. For since *Science* cannot be had but from *First Causes*, how will the same be attainable by us, if we do not know them? Seeing it is the Nature of *First Principles* to be *Clear* and *Evident*; and that the *Knowledge* of other things do so depend upon them, that tho' *Principles* may be known, tho' the *things* be unknown; yet the *things* themselves can never be known, except the *Principles* be known: Seeing therefore that GOD, the *Author of All Created Beings*, is (according to S. *Austin*) *the Light of all things knowable*, and *the Good of all things to be done*; we must *Know* him, before other Causalities can either have a Being, or be exactly known by us.

II. *All Geometrical Demonstrations derive their Evidence from the Existence of GOD.*

Notwithstanding that *Geometrical Demonstrations* be of that Evidence as to force our Assent, and being once clearly perceived, do no longer leave any place for doubting, as long as we attend to them; yet will they cease to appear such, if we be ignorant of the *Existence of God*. For how can we know, but that we are made with such Natures as to be deceived in those things that appear most evident to us? For we cannot be convinc'd to the contrary, except we first know *God* to Exist, and that He is the Fountain of all *Truth*, and hath not given us such *Understandings*, as to be deceived in the *Judgment* we make of things that we do most clearly and distinctly comprehend.

III. *We cannot be certain that any Conclusions are true, but only so long as we do give heed to the Premisses.*

True it is, that our *Mind* is conscious to several *Idea's* in it self, in the Contemplation whereof it never finds it self deceived, as long as it neither affirms nor denies ought concerning them. It is certain also, that it finds in it self Common Notions, whence it frames several *Demonstrations*, which it persuades it self to be very true, as long as it gives heed to the Premisses from whence it deduceth its *Demonstrations*. But because it cannot continually give its attention to them, and often forgets them, it may afterwards easily come to doubt

of their certainty, if it have not a clear and diſtinct Conception of *God*, that is, except it be aſſured that *God* is *True*, and that it is repugnant to his Nature to be a Deceiver. For as *Carteſius* ſaith in his Fifth Meditation, *Tho' I am of that Nature, that as long as I clearly and diſtinctly perceive any thing, I cannot but believe it true; yet becauſe I am alſo of that Nature, as not to be able always to fix the intention of my* Mind, *upon one and the ſame thing, in order to my clear perceiving of the ſame, and that I oft call to* Mind *a* Judgment *I have made before, when I no longer attend to the Reaſons, upon which I judged it to be ſuch, other Reaſons may be alledged, which might remove me from my* Opinion, *if I were Ignorant of the* Exiſtence *of* God; *and conſequently ſhould never have any true or certain Science concerning things, but only Fleeting and Mutable Opinions.*

IV. *This confirmed by an Example.* Thus he who conſiders the *Nature* of a *Triangle*, is indeed forced to conclude, that *its Three Angles are equal to Two right ones*, neither can he think otherwiſe as long as he attends to its *Demonſtration*: But yet as ſoon as he turns the bent of his *Mind* from it, tho' he remembers that he hath clearly perceived it, yet he may eaſily queſtion the truth of it, if the *Exiſtence* of *God* be unknown to him.

V. *An Objection taken from Atheiſts.* If it be ſaid that *Atheiſts*, who deny the *Exiſtence* of *God*, do notwithſtanding clearly underſtand general *Axioms*, ſuch as theſe, *Equal Quantities added to Equal, make the whole Equal*: *Thoſe things which agree in a Third, do agree amongſt themſelves*; and ſuch like: From which they eaſily Demonſtrate, that the Three *Angles of a right Angle, are Equal to Two right ones.* And that it is a thing apparent to all that are skilled in the *Principles* of *Geometry*, that the *Square* of the *Baſis* of a *Triangle*, is equal to the *Square* of the *Sides*: So that it is poſſible to have true knowledge, without ſuppoſing the knowledge of *God*.

VI. *Anſwered.* I Anſwer, That it cannot be denied, but that *Atheiſts* have a clear knowledge of *Geometrical Demonſtrations*, and that they are ſo evident, as to force their aſſent: But yet this knowledge of theirs cannot be ſaid to be true *Science*, founded upon certain *Principles*: Becauſe no knowledge deſerves the name of *Science*, that can in the leaſt be called in doubt, and whoſe certainty doth not depend on an evident *Principle*. Now foraſmuch as theſe Men are ſuppoſed to be *Atheiſts*, neither can they be certain that they are not miſtaken in thoſe very things, which they think themſelves to have moſt clearly apprehended. And tho' it may be this doubtfulneſs do not trouble them at preſent, yet it may hereafter, upon their examining of the matter, or upon its being ſtarted by others; neither can they ever be ſecured from this Heſitation, without owning *God* to be the *Author* of their *Being*.

VII. *Natural Theology influenceth all human Diſciplines.* NATURAL THEOLOGY Tranſcends all the *Parts* of *Philoſophy*; and as the *Sun*, that Enlightens all the *World*, is diffuſed through all *Arts*, and *Sciences*: For who is there, that conſidering the *Works* of *God* as he ought, doth not admire his *Power*, *Goodneſs* and *Wiſdom*, and is not raiſed thence to the *Knowledge* of *Him*? Do not the *Earth*, the *Water*, *Vegetables*, *Animals* and *Stars*, all lead us to the Underſtanding of Him? For all things have relation to *God*, as to their *Firſt Principle*, and proclain him to be the one *Supream cauſe* of their *Being*. For how is it poſſible for him, who attentively conſiders the *Connexion* of *Bodies*, the *Motion* of the *Stars*, the *Viciſſitude* of *Seaſons*, the *Succeſſion* of *Generations*, the orderly *Diſpoſition* of the *Parts* of the *World*, not to diſcern the Wiſe Author and Orderer of all theſe?

VIII. *The reſt of Bodies proves an Intellectual Principle.* *Bodies* have no power to move themſelves; how can therefore their ſo orderly Motion be perform'd, but by ſome *Intellectual Being*, by which as their *Effective Principle*, they are diſpoſed, and directed to their appointed end? Wherefore *Lactantius* was of Opinion, that no Man could be ſo Ignorant or Savage, but that, lifting up his *Eyes* to *Heaven*, tho' he may not know by whoſe *Providence* all theſe things are govern'd, yet muſt needs underſtand from the *Motion*, *Diſpoſition*, *Conſtancy*, *Uſefulneſs*, and *Contemperation* of things, that they are under a wiſe conduct; and that it is impoſſible, that what is ſo wonderfully framed and ordered, muſt be managed, by the higheſt Counſel and Wiſdom.

IX. *What Natural Theology is.* From what hath been ſaid it appears what *Natural Theology* is, *viz.* the *Knowledge* or *Science* of *God*. For *Theology* is divided into Natural and Supernatural; *Supernatural* is called that which is fetched from *Holy Scripture*, and which, by the aſſiſtance of *Supernatural Light*, attains Divine *Truths*: *Natural*, is that, which declares and demonſtrates the *Exiſtence* and *Attributes* of *God*, from the *Book* of *Nature*, and from *Principles*, derived from the *Light* of *Nature*.

X. *How uſeful the ſame is to Atheiſts and ungodly Men.* Wherefore, this *Natural Theology* is very profitable for Unbelievers, and Wicked Perſons, that are Theoretically ſo, who cannot be brought to any *Religion*, except it be firſt demonſtrated to them, that *God Exiſts*. As alſo for thoſe who are *Practical Atheiſts*, that is, who live, as if there were no *God*, no *Providence*, no *Reward* after this Life, nor any *Puniſhment*; for how will theſe be able to defend this their Opinion, after that they are once convinced, that there is a *God*, and that his *Attributes*, are not only ſhadowed out in all things throughout the whole *World*, but beſides are moſt clearly repreſented in their own *Souls*?

XI. *The Certainty of Natural Theology.* The Certainty of *Natural Theology* doth plainly appear, in that it is required to the laying of the Foundations of *Human Diſciplines*, and in that without the knowledge of *God*, no ſolid Knowledge can be had of any thing whatſoever. He cannot be called a *Philoſopher*, who is deſtitute of the knowledge of *God*, and who doth not worſhip him as he ought. Hence *Des Cartes* 1. *Princ. Artic.* 29. proves the certainty of the Natural Light given to him by *God*, by this Argument, becauſe *God* is True, and that he is the *Original* and *Principle* of our *Intellect*.

CHAP. I.

What God is, and how he may be reached by us.

I. *We are to enquire what God is, before we enquire whether he is.* FOraſmuch, as according to the *Rules* of *Logick*, we are never to enquire, *whether a thing be*, before we conceive *what it is*: I ſuppoſe it needful to examin, what the *Nature* of *God* is, and what is included in the *Eſſential* Conception of him, before that I proceed to the Diſcuſſing of the Point, how his *Exiſtence* comes to be known to us.

The

II. *All Men agree in the knowledge of God.*

The first of these will not be difficult, if we only follow the *Judgments* of *Men*, that ever had any Opinion of *God:* For I believe, that Men do less disagree in this, than in any other Opinion whatsoever. There is no Man that ever heard any thing of *God*, but doth acknowledge him to be a *Substance Infinite*, *Independent*, of the *Highest Understanding* and *Power*, and the *Creator* of all *things* that are. Or if he doth not distinctly conceive thus much, yet at least must own, that all Perfections that can possibly be conceived by Man, do belong to him in the highest and most perfect manner that can be.

III. *Tho' God be infinite, yet doth he not therefore exclude all Finite Beings.*

It may be some will here Object, that if *God* be an *Infinite Being*, or such a one as comprehends all manner of *Perfections* whatsoever, he must necessarily exclude every *Finite Being*, and so nothing would exist besides him. But the Falsity of this *Reasoning* is apparent; for we cannot conclude, that, because a Man hath a more excellent Wit than others, that therefore others have no Wit at all. Or supposing his Wit to encrease to *Infinity*, would this diminish the less Portion of Wit possest by others? Thus, tho' *God* be consummate in all manner of Perfections, yet doth not he therefore exclude all other *Beings*; except we should conceive *God* to be *Corporeal* and *Material*; for indeed if he were *Corporeally Infinite*, he must exclude all other *Bodies*. But if we should conceive *God* to be *Corporeal*, we cannot suppose him *Infinite*, that is, comprehending all manner of *Perfections*, because then he would be Divisible, and lose his highest Simplicity and Unity.

IV. *Gods Perfections are only Infinite.*

But some will urge further, that it is of the Nature of a most perfect *Being*, to include all manner of *Perfections*, and therefore it is necessary for him, formally to comprehend whatsoever *Perfection* is in the *Creatures*. To which I Answer, That the *Antecedent* is false, for seeing that the *Perfections* of the *Creature* are *Finite* and imperfect, they cannot be in *God*, because otherwise *God* could not be the most *Perfect Being*, as containing imperfections in himself. Wherefore we ought rather to say, since *God* is the *Highest Being*, he includes only *Infinite Perfection*, and excludes all other.

V. *How God is said to be Infinite.*

God is said to be *Infinite*, because he is without all *Bounds*, not only as to his *Essence*, but also as to his *Duration*, as being a necessary *Being*, and Subject to no Change or Mutability.

VI. *God is Independent.*

He is said to be *Independent*, because he derives his *Being*, from none besides himself. Which yet is not so to be understood, as if *God* did depend of himself, as of an *Efficient Cause*, since it might be still further enquired, whether that Cause had its *Being from it self* or *from another*. But that he is possest of so great and immense a *Power*, that he doth not stand in need of the help of any *Being*, for his *Existence* and Conservation; and that therefore in some *Sense*, *God* may be said to be the *Cause* of himself.

VII. *In what Sense God is said to be Positively of himself.*

You will say, that *Divines* will not allow this way of *Speaking*, as abhorring to admit the notion of *Causality* in *God*; and therefore when they would explain How *God* is from himself, they say, that that ought only to be understood Negatively, that is, *God* is not of another, but by no means positively of himself, as of a *Cause*.

I Answer, That it is true, that *God* is of himself Negatively, or which is the same thing, that he is not beholden to any *Cause* for his *Existence*; but withal do assert, that this Negation is not sufficient to explain the Nature of *God*, without admitting something that is positive, by which he continues to be or exist; and this we say is nothing else but his Inexhaustible and Incomprehensible *Power*; for it is certain that the *Power*, *Efficacy* and *Vertue* which we conceive in *God*, is the most Positive, Perfect and Real that can be: And therefore, forasmuch as *God* exists by reason of his *Nature*, or the *Perfections* that are in him, who can question but that he is positively of himself? For if the first Man had been from *Eternity*, so as nothing had been before him, yet forasmuch as the *Parts* of *Time* in which he *Exists*, may be separated from each other; and because from his *Being* to Day, it doth not follow that he shall be to Morrow, except there be some cause to renew him, and as it were, to produce him anew every *Moment*; we make no difficulty to assert that the *Cause* which thus preserves is something *Positive*. Thus notwithstanding *God* hath been from *Eternity*, yet because he himself preserves himself, we may conclude he is of himself, not only *Negatively*, but *Positively*, inasmuch as his *Immensity* is the Cause of the Perseverance of his *Being*.

VIII. *This Argument further urged.*

But you will say, if *God* be positively of himself, he will be his own *Cause*, or the *Cause* of himself, since he does the same with reference to himself, what the Efficient *Cause* doth with respect to its *Effect*. Now to say, that *God* is the *Cause* of himself, sounds harshly in the *Ears* of some *Divines*, and is looked upon as an Error.

IX. *Answered.*

I Answer, that *God* may be said, in some manner to be the *Cause* of himself, inasmuch as he is positively preserved by himself, as long as by the word *Cause* we do not understand the *Efficient*, but only the *Formal Cause*; so that the meaning of that Expression will be no more than this, that the *Immensity* of the *Divine Essence*, is the Reason why he doth not stand in need of any *Cause* for his *Existence* or Conservation; or that the *Divine Perfection* is so great, that he his the Reason of his own *Existence*, not diverse, but inseparable from himself. Which is not so to be understood, as if *God* by a Positive Influx did conserve himself, as all *Created Beings* are conserved by him; but only that this supreme Power, and the Immensity of his *Essence* is such, that he stands in need of no Conservator. But now who will pretend, that this Immensity of the Divine Power is not a most *positive thing*? When therefore it is demanded why *God Exists*, we must not answer, by an *Efficient Cause*; because that is properly called an *Efficient Cause*, where the Cause is distinguisht from the Effect, and where the Effect is supposed different from the *Cause*; but we are to Answer, by the *Essence* of the Thing or the *Formal Cause*, which bears some *Analogy* with the Efficient.

X. *God is conceived by all as supremely Intelligent.*

GOD is also acknowledged to be a *Being* of Sovereign *Wisdom* and *Understanding*, because nothing is hid from him, and because al past, present and future things are Naked, and open before him.

XI. *As most Powerful.*

Moreover *God* is acknowledged to be *most Powerful*, because he Rules over all, and can produce whatsoever doth not imply a Contradiction.

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XII. *In what sense God is said to be the Creator of all things.*

He is also owned to be *the Creator of all things*, because all *things* depend on Him, not only to their *Being*, but also with regard to their *Conservation*. For since *Infinite Power* is included in the *Idea* we have of *God*, it is a Contradiction, that any thing should *Exist*, which is not produced by him.

XIII. God *may be known by us, tho' not comprehended.*

Under these *Attributes* it is, that *God* may be known by us: For we have a clear and distinct knowledge of *God* as he is. *A Being Infinite, Omnipotent, Eternal, Omniscient, and the effective Principle of all things.* And he may be thus defined by us: *A Being thinking in Perfection* (or most perfectly thinking) *Simple, Unchangeable, Eternal, Consummate, Necessary, Immense, Incomprehensible, Omnipotent, and of which all things depend, not only with regard to their Nature and Existence, but also to their Order and Possibility.* Neither is it any Contradiction to what hath been said of our *knowing* him, that he is declared to be *Incomprehensible*: For it is one thing to *know* a thing, and another to *comprehend* it: I own that we who are *Finite* cannot comprehend the *Infinite Essence* of *God*, since it is of the Nature of *Infinity* to be *Incomprehensible*: But it is no Contradiction to say, we may know that which is *Infinite*, that is, clearly and distinctly apprehend a thing to be such, that no bounds or limits can be found in it, or set to it.

XIV. *A Objection fetch'd from the Divine Incomprehensibility.*

You will oppose, That if the Weakness of *Man* cannot aspire to the comprehension of that which is *Infinite*, he will never be able to conceive the Notion of that which is so, but only of that which is *Finite*: For who will say that he sees a *Man*, when he sees only one *Hair* of his *Head*? Now there is less proportion between a *Finite* thing and an *Infinite*, than there is between one *Hair* of a Man's Head, and his whole *Body*.

XV. *We may have an Idea of God, without comprehending of him.*

I Answer, That it is not at all needful, in order to our having the Notion of an *Infinite thing*, that we should comprehend all its *Perfections*, this being sufficient if we find no bounds or limits in it; because then we understand the whole *Infinite*, tho' not *Totally*, as the *Schools* term it, and as to every one of its *Parts*. Who dare say that I have not the *Idea* of a *Triangle*, when a *Figure* comprehended within *three Lines* is represented to my *Mind*; tho' it may be I am ignorant, that its *three Angles* be equal to *two* right ones? And so in like manner I may have an Apprehension or Notion of *God*, without comprehending all his *Attributes*. For if it were otherwise, I should understand nothing at all, when mention is made of the *Worship of God*, his *Works*, *Mercy*, or *Justice*. For it is not of the *Essence* of an *Image*, that it be in all things the same with the *thing* it represents, but only that it be in some degree like it.

XVI. *The word* Cogitation *is Equivocal.*

But yet we are to observe, that the word a *Thinking-Being*, or *Substance*, is Equivocal when attributed to *God* and the *Creatures*; because the *Cogitation*, which constitutes the *Nature* of *God*, is Independent and Perfect, and that which constitutes the *Nature* of a *Created Spirit* is Imperfect, and dependent of *God*: Wherefore to mark this difference, I say, that the *Cogitation*, which constitutes the *Nature* of *God*, subsists by it self; whereas that which constitutes the *Nature* of a *Created Spirit*, subsists indeed in it self, but not by it self.

CHAP. II.

By the Inborn Idea that is in us, we know that GOD exists.

I. *What we are to understand by the word* Idea.

BY the word *IDEA*, we understand that *form* of our *Cogitation*, by the immediate apprehension whereof we are conscious of the said *Cogitation*: So that we can express nothing, without having formed an *Idea* before of it in our *Minds*. Or to express it shorter, An *Idea* is nothing else but the *thing* it self perceived or thought of, as it is *Objectively* in the *Understanding*. Wherefore every *Idea* includes two things, the one *Formal* or *Proper*, inasmuch as it is an Operation of the *Mind*; the other *Objective*, as it is the Image of a *Thing thought*, or is instead of it.

II. *What distinction there is betwixt Idea's.*

In the *Second* place we are to tak notice, That tho' there is no inequality in the *Idea's* of our *Mind*, as they are *Modes of Thinking*; yet are they very different with respect to the *things* which they represent. For it cannot be question'd but the *Idea*, which represents *Substance* to me, contains more Objective Reality, than that which represents a *Mode*, or any thing else adventitious to a perfect or compleat *Substance*. And so that *Idea* which represents to me an *Infinite Being*, *All-powerful*, *All-wise*, *Eternal*, *&c.* doth undoubtedly contain more Objective Reality, than that which expresseth *Substances* that are *Created*, *Dependent*, *Mortal*, *&c.* For seeing that these *Idea's* are something, they must have a Cause of their *Existence*, and consequently have so much the more Reality, as the things they represent have of *Entity*.

III. *Whatsoever is in the Effect, is formally, or eminently in its Cause.*

Thirdly, we are to observe, That there is nothing found in any *Effect*, which is not *Formally* or *Eminently* contain'd in its *Cause*. A thing is said to be *Formally* in its *Cause*, when it is such there as we perceive; but *Eminently*, when the *Cause* can supply its stead. Thus *Fire*, when it produceth *heat* in a *Body*, is said to contain it *formally*, because it hath the very same thing in it self, which it hath produc'd in the *Body*; but the *Sun* and the *Earth*, when they produce *Fruits*, do not comprehend the thing caused by them *Formally*, but *Eminently* only. This *Notion* is the First of all others, and is as evident, as that *Nothing can be made out of Nothing*: For should we admit that something is contained in the *Effect*, which is not contained in the *Cause*, we must own that *Something* may proceed from *Nothing*. Neither can we give any other Reason, why *Nothing* cannot be the *Cause* of any thing, but because in it there cannot be found what is in the *Effect*.

IV. *From the Idea we have of God, we conclude that* God *is.*

Wherefore we conclude from the *Idea* we have of *God*, that he *exists*; which is, *First*, thus demonstrated: Every thing represented by an *Idea* must have a *Cause*, in which it is either *Formally* or *Eminently* contained; but we have an *Idea* of *God*, as he is a *Most perfect Substance*, excluding all Limitations: Therefore this *Idea* must have GOD for its *Cause*. The *Minor* is thus proved: There is nothing found in all *Created Beings* that can afford us this *Idea*: For tho' I can form the *Idea* of a *Substance*, because I my self am a *Substance*; yet will this *Idea* never represent an *Infinite Substance*, because I my self am Finite and of bounded *Perfections*; wherefore it is necessary that if I have an *Idea* of an *Infinite Substance*, it must proceed from *God alone*, who is *Infinite*.

If

V. *An Objection answer'd.* If you argue, that this *Idea* may be formed from the several Perfections scattered up and down in the several Parts of the *Universe*; after the same manner as from the Notion of an *Angel*, and my own *Mind*, I can frame an *Idea* of a *Divine Understanding*. I answer, How can I from the several Endowments of diverse Things, frame a *Being* that is absolutely Perfect? Shall I do it by enlarging and extending those *Images*? But whence have I the Faculty of enlarging all the Perfections of *Created Things*, and conceiving something that far exceeds them all? We ought rather to conclude, that this is, because the *Idea* of a most *Perfect Being* is impress'd upon my *Mind*. Moreover, the supream Perfection of *God* consists in this, That all his *Perfections* are not separate, as in the *Creatures*, but in conjunction with the most absolute *Simplicity* and *Unity*.

VI. *No Idea of an Infinite Being is contained in the Idea of a Finite Being.* And tho' the *Idea* of an *Infinite Substance*, which most perfectly includes all the *Perfections* our *Mind* can conceive, may also contain the *Idea* of a *Finite Substance*, (as a *Multitude* contains an *Unity*, and a greater Number a lesser;) yet is not the *Idea* of an *Infinite Being*, contain'd in that of a *Finite Being*. And therefore *Des Cartes* in his *Third Meditation* says thus: *I manifestly understand, that there is more Reality in an* Infinite Substance, *than in a* Finite; *and therefore that the Perception of an* Infinite Being, *is in some sort precedent in me, to that of a* Finite Being, *that is, the Idea of* GOD, *to that of my Self. For how could I understand that I Doubt, that I Desire, that is, that I want something, and am not altogether Perfect, if there were not in me the Idea of a more Perfect Being, by comparing my Self with whom I discern my own Defects?*

VII. *That which is Perfect cannot proceed from that which is Imperfect.* *Secondly*, That which is perfect cannot proceed from that which is imperfect, as from its *Total* and *Efficient Cause*: But we, as all other *Creatures*, are Imperfect; and the Perfections which are in *God*, are neither *Formally* nor *Eminently* contained in us: So that the *Idea* of *GOD*, which contains all his Perfections, cannot be thought to proceed from us, and consequently *God* must be the *Cause* of it; and because He cannot be the Cause of it, except He do *exist*, we may undoubtedly conclude that He doth so.

VIII. *The Idea of God is inborn in us,* If any one ask, whence we have this *Idea*, since it doth not proceed from our *Senses*, nor from any *Created Being*? My Answer is, That it is born with us, as the *Idea* of our Selves also is: For *God* impress'd it upon every *Man* in his *Creation*, and hath so order'd it, that every one should understand and know *God* by the same Faculty whereby He knows himself. For it is impossible that any one should understand himself to be imperfect, depending on another, and of uncertain Duration; but that at the same time he must also understand Him, with whom compared, he is imperfect, and on whom he depends; so that reflecting upon himself, he concludes that *God* is, and by the *Idea* which he hath of him, is convinc'd of his *Existence*. I say, by reflecting on himself; for by the impression made upon us by *God*, we are not to understand that this *Idea* is always actually represented to us; for were it so, we should always think of *God*: But by this *Impression* is meant nothing else, but that *God* hath vouchsafed such a Faculty to *Man*, whereby he can excite this *Idea* in himself, without the help of any other *Idea's* whatsoever.

IX. *The Idea of God cannot be said to be invented by us.* It cannot be said, That this *Idea* is framed or invented by us, as many *Notions* are, which have no other *Existence*, but what they have in our *Understanding*; because nothing can be added or taken away from this *Idea*, for *the Essences of things are indivisible*: So that if any Thing could be added to any *Idea*, representing the Nature of a *Thing*, it would be no more the same, but another *Idea*. And tho' new *Perfections* may still be perceived in *God*, which were not known before; yet doth not this change the *Idea* of *God*, but only makes it the more clear and distinct; no more than the *Idea* of *Man* is increased, when some new *Properties* are discover'd in him, which before were unknown, because they ought to have been included in the *Idea* which we had of him before.

X. *An Objection to prove, that the Idea of God is framed by us.* But you will farther urge, That *Man* who has this *Idea* is a free Agent, and that consequently he can frame the same at pleasure. And *Des Cartes* seems to hint as much in the *Beginning of his Fifth Meditation*, where after he hath said, That innumerable *Idea's* of Things are found in his *Mind*, adds, *Which tho' they be in some sort thought by me at pleasure*. Now if we can think of Objects according to our pleasure, why may we not say, that the *Idea* of *God* is framed by us, whilst we are thinking of it?

XI. *Many things occur to our Thoughts, which tho' they do not Exist, yet have their Nature.* I Answer, That *Idea's* do indeed depend on us, as far as they have a *formal* and *proper Being* in our *Mind*; but not as they are considered in their *objective Being*; because in that respect they have a necessary *Cause*. I own it to be in our power, to *think*, or not to *think* of any particular Object, and that we are thus free by a liberty of Contradiction, or by a liberty as to the *Exercise of the Act*, as the *Schools* express it; but that it is not in our power, to *think* differently of the same thing that is true, that is, we have no liberty of Contrariety, and as to the *Specification of the Act*. For it doth not depend on our *Will* to *think* the Number *Nine* to consist of three *Ternaries*, and not to consist, or to be an Even or Uneven *Number*, *&c.* Neither can we conceive a *Substance* absolutely perfect, as *Existing* or not *Existing*; *Wise*, or *Ignorant*, *Merciful* or *Cruel*; but must necessarily conceive him necessarily *Existing*, *All-wise*, and *All good*. Wherefore when *Des Cartes* saith, That many *Idea's* are found in him, which it may be have no *Existence*, besides his *Cogitation*, he presently subjoyns; *yet are they not feigned or invented by me, but have their true and unchangeable Natures.*

XII. *The Idea we have of God, is not derived from our Parents.* Neither doth it contradict our Assertion, what some say, That we have deriv'd all the Knowledge we have from our *Parents*, who having receiv'd the same from the first *Men*, afterwards communicated the same to us, and that consequently the *Idea* we have of GOD is not inborn, seeing that this Objection seems rather to confirm the *Idea* of GOD to be inborn in us: For let us ask them, from whom those first *Men* had this *Idea*; if from themselves; why may not we have it as well? If from GOD revealing the same to them, then they must own GOD to Exist.

CHAP. III.

That it belongs to the Nature of God to Exist.

I. *Whether Existence doth appertain to God.*

I Have evidently enough, as I suppose, Demonstrated in the foregoing Chapter, that because I find in my self the *Idea* of a *Being* absolutely *Perfect*, therefore that *Being* must *Exist*. Now I proceed to shew whether the *Existence* of *God*, can be proved from the consideration of his *Nature*, and whether a *Possible* only, or a *Necessary* Existence do belong to him.

II. *The Existence of any thing may be enquired into after a two-fold manner.*

Two *Questions* may be formed of a *thing* that *Exists* in *Nature*, the one with respect to our *Knowledge*, the other with repect to the *Thing* considered in it self. By the First, the Reason is sought, why any *thing*, suppose *God* or the *Soul*, is affirmmed by us to *Exist*: By the Second we enquire, how it comes to pass, that the said *thing* is not only Possible, but really *Existent*. By either of these ways we may enquire after the *Existence* of *God*, for we have Reasons that not only assure us that *God Exists*, but also that this his *Existence* is necessary.

III. *The Idea of an Infinite Being prove its Existence.*

Neither will it be hard to Demonstrate this, if we attend to the *Idea* we have of *God*, *viz.* that he is *Infinite*, all *Powerful* and all *Perfect*: For we argue thus: Whatsoever we clearly and distinctly perceive to belong to the *Essence* of any *Thing*, the same we know to be true as we perceive it; but we clearly and distinctly understand, that it belongs to the *Essence* of *God* that he *Exists*; therefore it is true that *God Exists*. The *Minor* is thus proved; It is a contradiction for a most perfect *Being*, to want any *Perfection*; but *Existence* is a *Perfection*; therefore *God* cannot be conceived, but *Existent*. For since where a *Multitude* is, there must needs also be a *Unity*; therefore since *God* possesseth all Perfections conceivable, he must of necessity also have *Existence*.

IV. *The Existence of God is necessary.*

Neither doth it oppose the *Truth* of what hath been said, that in all other *Created Beings*, the *Essence* is distinguisht from their *Existence*; and that it doth not follow, that a *thing* doth *exist* because we have a Notion of it. For the Reason thereof is, because in the *Idea* of all other *Things* only *Possible*, and not actual *Existence* is contained, whereas the *Nature* of *God* includes actual, necessary and *Eternal Existence*: So that it is as impossible for us to conceive a *Hill* without a *Valley*, as to conceive an absolutely perfect *Being*, to whom any Perfection is wanting, or who is not *Existent*: For as *Cogitation* supposeth the *Existence* of a *thing Thinking*, for if it had no *Being*, it could not *Think*: So absolute Perfection presupposeth necessary *Existence*, since nothing can be conceived absolutely perfect, except it *Exist*.

V. *Existence is a Perfection without which the nature of God cannot be conceived.*

Wherefore in this point, we differ from *Gassendus*, who denies *Existence* to be a *Perfection*, or the Propriety of any *thing*, but that which adds neither *Perfection* nor *Imperfection* to a *thing*. Because when we attend to the Notion of *God*, we perceive, that *Existence* is a *Divine Property*, and no less belongs to *God* than *Omnipotence* or *Immensity*, *&c.* or that an equality of *Angles* belongs to two Right ones. Because it belongs to the *Nature* of *God* to be; neither can he be conceived without *Existence*. For would not something be wanting in *God*, in case he did not *Exist*? Or how otherwise could he be said to be a *Being* absolutely perfect? Since *Existence is nothing else but the Reality of any thing, whereby it is placed out of Nothing*, which therefore no *Being* absolutely perfect, can be supposed to be without. For as *Cogitation* presupposeth the *Existence* of the thing that *Thinks*; so likewise, absolute Perfection requires *Existence*; because an absolutely perfect *Substance* cannot be conceived, but as actually *Existent*, and unchangable from *Eternity*.

V.

VI. *Objection.*

You will say: Tho' we cannot conceive a *Mountain* without a *Valley*, yet it doth not follow thence, that there is any *Mountain* in *Nature*, since a *Mountain* doth not include *Existence*: And therefore neither doth it follow that *God Exists*, because I conceive him as *Existent*. For there is no necessity laid upon things to *Exist*, from my Thought or Apprehension.

VII. *Answered.*

I Answer, That this Argument doth not proceed aright; for tho' a *Valley* enters the Conception of an *Hill*, and neither can be apprehended without the other, yet is it not inferred thence, that either a *Mountain* or *Valley* doth *Exist*; but that whether they *Exist* or do not *Exist*, they cannot be separated from each other. But seeing I cannot conceive *God* without *Existence*, I must conclude, that *Existence* is inseparable from him, and that therefore *God* cannot be conceived, but as *Existing*.

VIII. *An instance urged against this Answer.*

But you will further urge, that the *Sun Existing* doth essentially involve two things, *viz.* the *Sun* and the form of *Existence*, so that *Existence* belongs to this complex Notion of the *Sun Existing*. But *Gods* knowing this complex Notion from *Eternity*, doth not impose a necessity of *Existing* upon the *Sun*, without presupposing its actual *Existence* in the *World*. So likewise tho' *Existence* be contained in a *Being* absolutely perfect, yet cannot we conclude thence that it actually *Exists*, except we suppose it to include *Existence*, as well as the other Perfections.

IX. *The instance Answered.*

I Answer, That in the *Idea* of an *Existing Sun* there is only a Possible, but not a necessary *Existence* contained; because we do not understand that *actual Existence* must of necessity be joyned with the Properties of the *Sun*; for tho' it be conceived as *Existing*, yet doth it not follow thence that it doth *Exist*; forasmuch as this complex Notion, the *Existing Sun*, may be framed by the *Understanding*; and that these two Notions may be separated, not only by *Abstraction*, but also by a clear and distinct Operation, so as that the *Sun* may be conceived without *Existence*. Whereas, in the *Idea* of *God* actual and necessary *Existence* is involved, which hath an inseperable Connexion with the rest of his *Attributes*. So that it is impossible to conceive an *Infinite Being* to have all Perfections, except it do actually *Exist*. For necessary *Existence* is the *Property* of *God*, which agrees to him alone, and makes a part of his *Essence*.

X. *The Idea of every thing doth not argue actual Existence.*

Wherefore, when we enquire, whether the *Existence* of a thing absolutely perfect can be inferr'd from its *Idea*, the *Question* is not, whether out of every Conception or *Idea* of a *thing*, we can Demonstrate its *Existence*; but only whether from the *Idea* we have in our *Mind* of a *Being* absolutely perfect, we may rightly conclude its *Existence*. For it is a Fallacy, when we bestow an *Attribute*, that agrees only to one Subject, upon all. Wherefore I do rightly and demonstratively conclude, that if necessary *Existence* be contained in the *Idea*

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of *God*, that is, if by a clear and distinct Perception, I cannot divide actual *Existence* from his Nature, *God* must necessarily *Exist*; by the same necessity that the Nature of Man doth consist of *Soul* and *Body*, and that a *Valley* includes the Conception of an *Hill*.

XI. *The Essence of God is not a Figment of our Understanding.*

Some with whom I have Discoursed about this Point, deny the *Essence* of *God* to subsist any where but in our *Mind*, and that it is nothing else but a figment or thing feigned by the *Understanding*. But this is easily overthrown by shewing, that necessary *Existence* is not included in any Fiction of our *Understanding*. Besides, the *Essence* of *God* is either Possible, or Impossible; if they grant the first, it must necessarily *Exist*; for what other *thing* can impart *Existence* to a thing that is *Possible*? If they say it is *Impossible*, it will lye upon them to prove the Contradiction it implies.

XII. *The Existence of God may be proved from the Conservation of us.*

The *Existence* of *God* may also be proved from our continued *Preservation*. For seeing that a *Creature* hath no power to preserve it self, we must have recourse to some *Cause* that preserves it. *Time* we know is divided into many Parts, which are independent of one another; since a Thing under *Duration*, may every particular Moment cease to be; neither doth it follow, because it was yesterday, that it must be to day; wherefore there must be some *Cause* to preserve it, and as it were to produce it anew every Moment, which its self cannot do, no more than it could at first give its self a *Being*. For *Conservation* is not distinguishable from *Creation*, but only by Reason; neither is there any less power required to Conserve a thing, than to produce it: Neither can *Parents* do this, since they only procure some Dispositions in the Matter, to prepare it for the *Reception* of the *Soul*, and we may Live after they are Dead: Wherefore there must of necessity be some first *Cause*, which may not only create and produce us, but also keep and preserve us.

XIII. *How it is to be understood that things cannot preserve themselves.*

If you oppose to what I have here alledged, the *Law* of *Nature* set down by *Des Cartes*: *That every thing, as far as in it lies, endeavours to continue in the same State, neither is ever changed, except it be forced to it by a foreign Agent*; and that according to this *Law*, every thing which *Exists*, must continue always to *Exist*, neither stands in need of any new force, whereby to be sustained in its *Essence*. I Answer, That whatsoever is besides *God*, is a *Being* depending on another; and whatsoever once essentially depends on another, must of necessity, for always so depend on it, because what is *Essential* admits of no change; and so great a *Virtue* is required in an *Independing Being*, that all things depend on it, as in the First Moment, so also in the Second, Third, &c. Wherefore when it is said, that every thing, as much as in it lies, continues in the same State; this must be understood with regard to the *Perfection* or *Nature* which hath been given to it, to which *God* who is constant and unchangeable, is supposed to afford his continual concourse.

XIV. *An account of what is to be handled in the following Chapter.*

Tho from the *Idea* we have of *God*, and from the Contemplation of him, and our own Conservation, his actual *Existence* is evidently deducible; nevertheless we will also endeavour to make out the same from all Sensible *Objects*. This was not undertaken by *Des Cartes*, forasmuch as he being chiefly intent on the *Idea* of *God*, had not yet discovered Material things, and therefore could not properly alledge any Argument from their Production.

CHAP. IV.

The Contemplation of the World proves the Existence of God.

I. *The first Argument for the Existence of a God from the Fabrick of the World.*

ALmost all the *Philosophers* that ever duly considered the *Miracles* of *Nature*, constantly acknowledged an *Eternal Godhead*, by whose out-breathing all things are Quickned, and receive *Life* and *Heat*. For who is there so stupid, who from the Stupendous Structure of the *World*, the continual Rotations of the *Heavens*, and the never discomposed order of *Nature*, doth not necessarily infer, that there is a *Supreme Creator*, who doth govern the *World*, as *Boethius* saith, by *Perpetual Reason*, at whose command *Time* is, and who being Stable, and Immoveable himself, imparts *Motion* to all *things*? What else doth the vast extent of this *World*, the variety of *things* therein contained, the Beauty of its *Parts*, the constancy of its *Motions* Preach to us, than that there is a great *Moderator*, who is the *Author* of this Transcendent *Structure*, and the Original disposer of this Harmonious Order?

We all are link'd to God, *a silent Breast,*
His Temple is. ———
What is the Place *of* God *but* Heaven *and* Earth
The Air *and* Seas, *to which he's given Birth?*
What but a Vertuous raised holy Mind?
Where if we can't, we'l scarce him elsewhere find.
All that thy Gazing Eye *doth see, and all*
That doth thee move, is that which God *we call.*

Lucan. lib. 9.

II. *Order supposeth an understanding Artificer.*

I will own that some mean *Philosophers*, may rest in the Contemplation of *Second Causes*, and entertain their *Minds* with the consideration of *Natural Objects*, without looking further. But it is impossible, that he who attentively considers their *Subordination*, and diligently weighs their Connexion, should not be forced to own a *Creator* of *Heaven* and *Earth*, and acknowledge his perpetual Providence, *except* (as *Aristotle* saith) *he be so unhappy, as to be fallen into the deepest Gulf of Blindness and Misery*. But that we may illustrate this a little by an Example, Let us suppose that *Protagoras*, or some other *Atheist*, had got a view of *Archimedes* his *Glassy Sphear*, in which the *Heavens*, I say, perform their several *Motions*, where the *Sun* and *Moon* do by degrees withdraw themselves towards the *East*, and being hurried along by the *Primum Mobile*, are whirld about, within the space of Twenty four hours; Do you think that *Protagoras* would have believed this *Machine*, to have been jumbled together by Chance, by a Fortuitous Concourse of the *Parts*, and not much rather that it was the *effect* of *Art*, and of the *Brain* of a most Subtil and Accomplisht *Mathematician*? For seeing it doth chiefly belong to an *Intellectual Agent*, fitly to adapt divers *things*, and to dispose them according to his designed end, he will be forced to confess that such an accurate and in-

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genious piece of Work, muſt have proceeded from *Reaſon*, and not from a Chance-medly of *Atoms*.

III. *Never were any Miracles wrought for the Conviction of Atheiſts.*

But if it be lawful to compare Great things with Little, and Weak things with ſuch as are Perfect, what is *Archimedes* his *Sphear* in compariſon to this *Univerſe*? How much more Perfect is the *Original*, than the *Copy*? And ſhall we believe that *Archimedes*, in his Imitation of the *Motion* of the *Wandring Stars*, made uſe of *Reaſon*, and at the ſame time ſuppoſe, that this infinite number of *Stars*, this wonderful adorning of the *Heavens*, this excellent Order of an unutterable variety of *Works* were the product of caſually jumbled and juſtled *Atoms*? This can never be ſuppoſed by any one in his right Wits: And he that hath either outward *Eyes* to ſee with, or an *Underſtanding* to diſcern, can never ſubmit to what is ſo contradictory to *Senſe* and *Reaſon*. For this cauſe I ſuppoſe it is, that GOD who diſpoſeth all things in *Number*, *Weight*, and *Meaſure*, and who takes ſo great Care for *Mankind*, yet hath never been known to work any *Miracles* in favour of *Atheiſts*; becauſe the Workmanſhip of *Nature* is not only a convincing Argument of his *Power*, but doth alſo ſtrongly invite and perſuade us to the higheſt Admiration of all his *Divine Perfections*. And to ſpeak the truth, I could much more eaſily believe all the Fables of *Æſop* for true *Hiſtories*, and that *Mice* had conferences together, and that a *Weeſel* entertain'd a witty Diſcourſe with the *Fox*, than that the *Riſing* and *Setting* of the *Stars*, the *Viciſſitudes* of *Day* and *Night*, the *variety* of *Seaſons* in the Fourfold divided *Year*, the two *Æquinoctials*, and as many *Solſtices*, could ever have been ſo ordered, without the *Divine*, that is, the moſt *Perfect Reaſon*; or preſerv'd in the ſame, by an invariable and uninterrupted Succeſſion. For do not all theſe, and all the other *Wonders*, with a conſtant and never ceaſing Voice ſeem to proclaim, that they are the Off-ſpring of an *Inviſible Sovereign Power*, and by no means their own *Artificers*? *He hath made us, and not we our ſelves.*

IV. *The various Species of Animals prove the Being of a GOD.*

But that I may not inſiſt too long in laying open the Beauty of the *Univerſe*, I will paſs by the vaſt Globe of the *Earth*, poiſed in the midſt of the *Air*, the *Mountains* lifting up their Heads towards *Heaven*, the *Rivers* that water and fructifie the *Earth*, the prodigious variety of *Vegetables*, which grow of themſelves, and the vaſt number of *Mines* and *Quarries*, from which *Gold*, *Silver*, and the reſt of the *Metals*, with ſeveral ſorts of *Earths* and *Stones* are dug. Let us only conſider, the almoſt infinite differing kinds of *Living Creatures*, whoſe oppoſit outward ſhape, and the great and many Conveniences and Neceſſaries they afford to *Mankind*, declare them to be the effect of the One only *Firſt Principle* or *Author* of all things. For who can imagin that the difference of *Male* and *Female*, the deſire of Mutual Embraces, and of perpetuating themſelves by their *Poſterity*, and Organs fitted for that purpoſe, were deſign'd and contriv'd by any thing leſs than a *Wiſe Omnipotence*? Who is there, that upon a diligent view of the ſeveral ſorts of *Birds*, their aſtoniſhing Artifice in making their *Neſts*, their *Hatching* and care of *Feeding* their *Young*, their dexterouſneſs in teaching them to *Fly*, doth not preſently diſcover the *Supream Cauſe* of them, who with wonderful Wiſdom and Artifice hath contriv'd and order'd all things, and hath imparted ſeveral *virtues* and *forces* to different *Animals*, according to their various uſe and capacity? How exquiſitely is their whole frame ſuited to the uſe for which they are deſign'd, and how accurately are their *Organs* adapted to their ſeveral Actions? Thus *Bulls* are furniſh'd with *Horns*; *Lions* with their *Paws*; *Elephants* with their *Teeth* and *Snout*; and the *Rhinoceros* with his cloſe *Armour*, as well in order to the attaining of their deſigned End, as to defend themſelves, and offend their Enemies.

V. *The various Faculties in Beaſts, plainly prove a Sovereign or Supream Power, ordering and deſigning all things.*

Shall any one be ſo weak as to think, that broad and flat *Feet* were given to *Water Fowl* without any deſign, and by meer hap-hazard, when the uſe of them in *Swimming* is ſo apparent? Can any one ſuppoſe that *Herns*, ſhould by chance, have long *Legs* and *Necks*, and *Beaks* ſharp-pointed like *Daggers*, wherewith they pierce the *Fiſhes*, and draw them out of the *Water* for their prey? Whench hath the *Pike* his prominent *Saw*-like *Teeth* on each ſide his *Jaws*, and the *Roof* of his *Mouth* thick ſet with *Hooks*, that the ſlippery Prey might not eſcape his greedy Jaws? Is it by chance that the *Woodpecker* is furniſh'd with *Claws*, wherewith it runs up the ſide of *Trees* like a *Cat*, and a forked *Tongue*, wherewith it robs the *Tarantula* of her Prey? Conſider the Arts and Induſtry of the *Bees*, *Piſmires*, and other *Beaſts*, about their *Food*, begetting of their *Kind*, breeding of their *Young*, and fighting with their *Enemies*, and it will appear ſelf-evident, that none of theſe can be ſuppoſed the *fruit* of an Accidental and Confuſed motion of *Atoms*, foraſmuch as nothing more excellent, more appoſit or uſeful, can be conceived by the *Mind* of *Man*.

VI. *The beholding of Man, leads us to the knowledge of GOD.*

But to make no longer ſtop here, let us take a view of *Man*, *Nature's Maſterpiece*, and behold all the Excellencies diſpers'd up and down in all other *Living Creatures*, united in this *Microcoſm*, or *Little World*. Can any one behold his comly *Form*, the erect poſture of his *Body*, his *Face* looking upwards, and (as it were) directed towards *Heaven*, and the Beautiful ſymmetry and proportion of his whole *Body* and *Parts*, and ſuppoſe him to have had no *Author* of his *Being*? But to leave the Wonders of his Outſide, if we proceed to take a view of his *Inward Parts*, their ſtructure and ſituation, the *Nerves* and *Sinews* deriving their Original from the *Brain*, the *Arteries* from the *Heart*, the *Æthereal ever moving Spirit* that fills them, and imparts *motion* to all the ſeveral *Joynts* and *Members* of the *Body*, and vigour and ſtrength to perform all manner of *Actions*, we ſhall find ſtill ſtronger Arguments to perſuade us, that there muſt be a *Firſt Cauſe*, who is the Principle of all *Human Perfection*.

VII. *The deſcription of the Eye, as to its External parts.*

But foraſmuch as Vulgar Wits are more apt to be taken with *Examples* than *Diſcourſe*, let us take to task ſome one Part of the *Body* of *Man*; for Example, the *Eye*, and ſcan the Miracles it contains. And here at firſt ſight we meet with ſo many Wonders in its moſt curious Make and Contrivance, that it is impoſſible for a *Man*, not wholly bereft of *Reaſon* and *Underſtanding*, to doubt of the Sovereign Perfection of the *Artificer*. In running over its outward Parts, we meet with the

Bony

Bony Orbit, or round *Ossea Orbita*, together with the *Eyelids*, the *Hair* of the *Eyelids*, and the *Eyebrows*, as also the *Glandules* or *Kernels*, with the *Excretory Vessels* and *Passages*, all which serve either to defend that tender Part, or assist and facilitate its *motion*. The *Eyelids* are as *Curtains* to the *Eyes*, and are assisted with the ministry of several *Nerves*, which by insertion into the *Muscles*, become useful for the opening or shutting of them. The *Eyebrows* and *Hair* on the *Eyelids*, are like Ramparts, to secure the *Eye* from things that are hurtful to it, and to prevent their sudden and unexpected eruption. The *Excretory Passages* serve to carry off the superabounding Humor, that the *Eye* may not be clog'd by the affluence of *ferous Matter*, or the *Eyesight* dimmed by the acrimony thereof.

V.

VI.

VIII. *The Inward Parts of the* Eye *consider'd.*

If we proceed to the Inner Parts, which Nature hath hid from, but Anatomy lays open to us; we shall first find the *Muscles*, wherewith this miraculous little *Globe* continues hung up and equally pois'd within the *Orbit*, and performs its various *motions*. In the Midst of it is the *Pupilla*, or *Sight*, of a round *Figure*, that the visible *Species* or *Rays* proceeding from *Objects*, might be the better received by it, from what part soever of the *Hemisphere* they come. After these appear the *Coats*, or *Membrans* of the *Eye*, and next the *Humors*, which like a *Dioptrick-Glass* do refract and concenter the *Rays* that represent the Images of *Bodies*. For the *Watry Humor* distending the *Membran*, and making it gibbous, doth ampliate the *Convexity* of the *Eye*: And the *Crystalline Humor* placed within the opening of the *Grape-like Coat*, *Tunica Uvea*, like a piece of *Glass* set opposite to a Hole, in which the Rays coming from all parts are collected and refracted. And behind the *Crystalline Humor* is placed the *Glassy Humor*, by means whereof the *Tunica Retina*, or *Network Membrane* is at a fit distance separated from the *Crystalline Humor*, so that when the *Rays* with due refraction have past the same, they attain their proper place and center.

IX. *The structure of the Ear examin'd.*

Tho' the *EAR* be not of equal use and concern to the convenience and necessities of Life, as the *Eye*, and is only design'd for the perceiving of *Sounds*; yet is it for the Excellence of its structure very little inferiour to that of the *Eye*, especially if we consider its Inner parts, and the mutual connexion of them. For from the *Lappet of the Ear*, which is narrowed by degrees, we see that the Hollow of the *Ear* goes slanting inwards, to the end that the *Sounds*, by passing its crooked Windings and Turnings, might be encreased. For the thin *Membrane*, placed near the Hole of this inward Cavity, being struck by the impuls'd *Air*, doth affect the *Fibres* and *Auditory Nerve* with the same motion. There are also three small *Bones* fitly disposed and tied together with a *Ligament*: The first of these is call'd the *Hammer*, because of the resemblance it bears with that Instrument; the second is call'd the *Anvil*, which is somewhat roundish; and the third, the *Stapes* or *Stirrop*; they are moveable, and seem to be of good use to defend the *Drum* of the *Ear*, and prevent its being too much slackened, or too stiff bent. From the fore-mention'd Hollow of the *Ear*, the Passage (commonly called by *Anatomists* the *Oval Hole*, or *Window*) opens into the *Labyrinth*, and so leads to the last *Inner Cavity*, called *Cochlea*; because in its Spiral Windings it resembles a *Snails Shell*, which if well view'd, appears to be the work of admirable Artifice; for being form'd with such Turnings, it renders the *Sounds* more distinct, and causes that there be no confusion of them. Besides, there are many other Parts not here to be insisted on, whose wonderful Contrivance does much conduce to *Hearing*.

X. *The structure of the Eye and Ear, cannot be the effect of a Fortuitous Concourse of Atoms.*

Now who can be conceived so stupid and void of all *Judgment*, as to think that the *Organs* of these two *Senses* were made by a fortuitous jumbling together of small *Bodies*; and not rather acknowledge the most *High God*, who by his inimitable *Wisdom* has so curiously framed, and orderly disposed all these several *Parts*, that nothing can be imagin'd more adapt, and better suited to the uses for which they were designed.

XI. *Living Creatures could never be by Chance.*

I could never approve of *Democritus* his Opinion, which attributes the Original of the *World* to a company of *justling Atoms*, as if their Roaming vagaries were an adequate Cause to produce all the *Bodies* in the *Universe*. For how can we suppose, that in that infinite Space, wherein he asserts his *Atoms* to be toss'd, they should come together and unite, to the framing of all the *Parts* of *Living Creatures*? Can we imagine, that by the hudling concourse of like *Bodies* so many *Nerves* and *Muscles*, so many *Ligaments* and *Tendons*, so many *Filaments* and *Fibres*, could be formed? Can we think that the *Legs*, *Shins*, *Feet*, *Toes*, *Joynts*, with all the other Organs of the *Body*, were the effect of blind and impotent *Chance*? Can we conceive that the *Heart*, that Noble *Muscle*, and the *Breast* in which it is contain'd, together with its *Ribs*, *Muscles*, the *Lungs*, and the *Midriff*, were made without a Cause and at Hap-hazard? Or that such a vast number of *Veins*, *Arteries*, *Grissels*, and *Membrans* had no other rise, but meer *Chance* and the Heavines of *Bodies*? Who can force himself to imagine, that an infinite number of *Blind Men* plac'd in an open Field, by a confused running in amongst one another, should at last produce an *Army* orderly drawn up in *Battle*, according to the most exact Rules of *Military Art* and *Discipline*? Or why may not we as well with *CICERO*, suppose that a vast number of *Alphabetical Characters*, being casually thrown upon the *Earth*, should all rank themselves into *Lines* and *Words*, making the *Annals* of *ENNIUS* the Poet? Now as no Man can so much over-bear his *Reason* as to think this possible, how much less will he be able to believe, that the curious Structure and Order of the *Parts* of *Animals*, is the effect of *Chance*, that is, of no Cause at all?

XII. Atoms *cannot produce any thing of themselves.*

And to deduce this matter from the Beginning of the *World*; If it be so that *Atoms* have a Power to produce and generate things, why do they not now produce or renew the same Things they framed so long ago; why are there no *Mountains* raised anew? How is it that they do not constitute another *Sun*? How it comes to pass that all *Living Creatures* keep to their kinds, and that no new ones do arise from their Sensless Jumbling together? Neither will it be of any advantage for the *Atheist* to alledge here, that *Flies*, *Mice*, and other *Insects* are daily generated without the Union of both *Sexes*; because the Question here is not concerning the Production of Things, but

concerning the inborn Power of Nature, or *Seeds*, out of which *Living Creatures* are Born, and are endowed with a Virtue fit for the *Generating* of them. And seeing they have not this of themselves, since it is a contradiction for a thing to be productive of it self, it must follow that they are the effect of the *All-wise God*, by whose power they act whatsoever they do.

CHAP. V.

Concerning Fate and Will, or the Divine Decree.

I. *The Ancients took great Pains to reconcile the Divine Preordination with the Liberty of Mans Will.*

THE *Ancients* were so solicitous of Preserving *Human Liberty*, that when they found they could not reconcile them with some of the *Divine Attributes*, they chose rather to acknowledge their own Ignorance, than to deny it. For when they found that all our Actions must be pre-ordained by *God*, forasmuch as he is the All-knowing Governour of the World; and on the other hand experienced in themselves a Freedom of Will, they admitted both to be True, *viz.* that *God* doth preordain all our Actions, and that we nevertheless enjoy Liberty of Will. But when they afterwards proceeded to enquire further, how it could be, that Mans Liberty standing, *God* could have fore-ordained all things from *Eternity*, they ingenuously profest their Ignorance, and that it was no wonder, that an *Infinite Being* could not be Comprehended by a *Created Understanding*. This acknowledgment of *Human* Frailty was certainly praise-worthy in them: But forasmuch as all are not satisfied with this Answer, many being solicitous to know how the Liberty of Man may be reconciled with *Gods Decree*, I suppose it will not be useless to make out, that *Gods Foreknowledge* of and *Foreordination* of *Human actions*, doth not take away the Liberty of them.

II. *What Fate or the Divine Decree is.*

And here if we consider the *Nature* of *Fate*, or the Divine Decree, we shall find it to be nothing else, but what *God* hath determined concerning every one of us: Or it is the *Eternal Decree* of his *Providence*, by which he *Sees*, *Knows* and *Governs* all things. And as *BOETHIUS* expresses it; *Fate is an Order or Disposition, Inherentin changeable things, by which Providence links them to their due Ranks and Orders.*

III. *Fate lays no necessity upon Human Actions.*

Now that this Order or Disposal doth impose no necessity upon *Human Actions*, is apparent, because we find that it is in our Power, to give our *Assent* to, or to *Dissent* from many things, and after haveing ballanced both parts, to choose one, and reject the other. We see likewise that Men frequently change their *Minds* at the Persuasions of their *Friends*, and do refuse what first they had embraced. And indeed were it otherwise, all *Prudence* and *Reason* in Mens ordering of their affairs would be taken away; for if they had no Freedom to chuse that part, to which they are inclined by Rational motives; they would not act by the direction of Wisdom, but by Chance and Fortune.

IV. *It is an Argument of our weakness, that we cannot reconcile Gods omnipotence, with the liberty of our will.*

And what can be more absurd than to go about to deny our *Liberty*, which we experience in our selves, and whereof we are so fully Conscious, that nothing can be more illustrious by the *Light of Nature* than it is, because we can scarcely reconcile it, with the *Divine Omnipotence* and *Providence*? We ought ever to remember that we are *Finite*, and that *God* is *Infinite*; and that our Liberty must not presently be denied, because we cannot conceive it inconsistence with the *Will* of *God*, which is without us, and which our Minds are not able to comprehend; forasmuch as this only proceeds from the weakness of our *Wit* and *Understanding*

V. *The Decree of God doth suit it self and comport with things.*

'Tis true indeed that *Fate* is immoveable, but yet so as that it inheres in things that are moveable; because it doth not take away the Nature or inbred Motions of things, but moves them sweetly and without any manner of constraint; according to the Requirings of the different Nature of *things*, so as to act *necessarily*, with things necessary, and *freely* with free and voluntary *Agents*.

VI. *Gods Foreknowledge lays no necessity or force upon Mans will.*

Neither is this Assertion overthrown by that common Objection: *If God foresees that I shall Sin, seeing that his Foresight cannot be deceived, it follows that I must necessarily Sin.* For *God* doth not foresee my Sinning *necessarily*, but *freely* and voluntarily; and his Knowledge imposeth no necessity upon my Actions, no more than my knowing that *Peter* will walk to morrow, doth lay a necessity upon him of doing so: Or than the knowledge I have of the *Suns* Existence in the *Heavens*, doth cause the *Sun* to be there.

VII. *The knowledge of God being external to the thing known, cannot hinder its Liberty.*

For what can be more Childish than to think, that the *Foreknowledge* of *God*, which is altogether External to the *thing known*, should put a force upon the Will of Man? But you will say, *God* cannot be deceived. And what then? Consequently, you'l say, it was either true from *Eternity*, that you were to recover of this *Sickness*, or else false: Therefore it is in vain to make use of a *Physician*, since neither the necessity of *Fate*, nor *Eternal Truth* can ever be changed. This is worthily stil'd by *CICERO* to be a lazy *Question*, because by the same *Argument* you may overthrow all *Human Actions*. But that *Gods Foreknowledge*, doth not import any necessity is evident from this; that a *Contingent thing* is of its own nature Indefinite, and of a doubtful event, tho' with respect to the *Divine Foreknowledge*, it be Definite and determined. *AMMONIUS* illustrates this by the Example of a *Globe*, resting on the Plain of the *Horizon*, the indifferency whereof as to Rest or Motion, doth well express the indifferency of our Will; but if this Plain be never so little inclined, then it must move of necessity: So likewise when the Will is inclined to any thing, this makes a kind of necessity, upon Supposition only, that the *Will* turned it self thisway; or that *God* did foresee this inclination from *Eternity*.

VIII. *The certainty of Gods Foreknowledge is no Argument for a force upon our will.*

You will say, *Gods Prescience* is most *certain*; therefore its Object cannot but come to pass; and that which cannot but come to pass, is therefore necessary: Therefore, *Gods Foreknowledge* imposeth a necessity on the *Will*. I Answer, by distinguishing the Consequent; I grant that the thing which is the *Object* of the *Divine Foreknowledge*, cannot but happen *upon Supposition*, that it is to happen so, from a necessity of *Consequence*; but I deny that it cannot but come to pass *absolutely*, and by a necessity of *Antecedence*.

IX. *There is a two-fold necessity.*

There is a two-fold necessity, the one *Antecedent*, and that is that which is the *Cause* of the *Action*, which necessity the *Will* cannot resist: The other is *Consequent*, which is not the *Cause* of the *Action*, but doth presuppose it, and is consequent to it. And it is this latter only which is brought upon *Human affairs*, by the *Divine Prescience*:

Foras-

To the Wor= shipfull Cap=
taine Richard Cheyney of Ham=
erton in the Parish of Hack=
ney in Middle= sex Esqr.

This Plate is humbly Dedicated by Richard Blome.

Forasmuch as a futurity is not the Consequent of *Gods Fore-knowledge*, but his *Prescience* is the Consequent of that which is future; and in this Sense only it is, that the Object of *Gods Prescience* is called Infallible and Eternal.

CHAP. VI.

How God is said to be the Cause of Propositions of Eternal Truth.

I. *How the Essences of things are distinguisht from their Existency.*

FOr the better understanding of this *Question*, we are briefly to presuppose, that the *Essences* of *things* are modally distinguisht from their *Existency*: For we understand the *Essence* of a *thing* after one manner, when we abstract it from *Existence* or non *Existence*; and after another when we conceive it as *Existing*. For a thing is understood to be *Existent*, when it is *without our Understanding*: But a *thing* that doth not *Exist*, is *objectively* in our Understanding, and is not *without our Thought*. Of this kind are *Eternal Truths*, *viz.* That *a Triangle hath three Angles equal to two right ones*: *Six and Four make Ten*; and such like, which are considered as *Ideas* in our *Mind*. And forasmuch as these *Idea's* cannot be said to be nothing, but something, the *Questions* is, what is the cause of them, that is, whether they depend on the *Understanding* of *Man* forming them, or whether they owe their production to some other *Principle*.

II. *God is the cause of Propositions of Eternal Truth.*

I Answer, that all *Eternal Truths* are from *God*, as from their efficient and total *Cause*; for he is the *Cause* of all *Creatures*, not only as to their *Existence*, but also with regard to their *Essence*. Forasmuch as he being *Infinite Goodness*, could not be impulsed by any other Reason of *Goodness*, to do that which is best: But on the contrary because he determined himself to produce the *things* that are, therefore they deserve the Title of being *Good*. As for Example, he did not therefore will the three *Angles* of a *Triangle* to be equal to Two right ones, because he saw, that they could not be otherwise; but on the contrary, because according to his *Free-will* he had determined the three *Angles* to be necessarily equal to Two right ones, therefore they could not be otherwise. For in *God* to *Will*, to *Understand* and *Create* are one and the same thing: Wherefore because he knows a thing, therefore it is true.

III. *The non-Existence of God being supposed nothing is less true.*

Neither can we say, that these *Truths* would be no less true, whether *God* be supposed to *Exist* or not: For this is most false; because all *Truths* depend upon the *Existence* of *God*, who is the first *Eternal cause* of them, from whence they all flow as from their Fountain. Neither is this difficult to be conceived, if we consider *God* as an *Infinite*, *Eternal*, *Incomprehensible Being*, the *Author* of all *Good*, and on whom all things depend. And therefore they are in a great Error, who think that any thing can be independently of his *Will*.

IV. *That twice four make eight is from God.*

Neither doth it oppose what we have said, that the *Mind* of Man cannot conceive *the three Angles of a Triangle not to be equal to two right ones*; or that *twice four should not make Eight*: For to prove this, it is sufficient to shew, that there can be no *Being* which does not depend on *God*, and was not freely constituded by him: For this being laid down, it evidently follows, that it was not always necessary, that the three *Angles* of a *Triangle* should be equal to two *right ones*, or that twice four should make eight, but that it was so constituted by *God*.

V. *God being of himself there is nothing independent of him.*

For seeing *God* is positively of himself, he is endowed with such an *Essence* and *Nature*, that from the consideration thereof we can assign a *Reason* for *Eternal Truth*, without need of having recourse to any other *Object*, for the clearing of their Evidence and certainty. This *Attribute* would agree to some other besides *God*, if we should suppose some *Natures*, *Truths* and *Essences* to be such as to be independent of *God*. Because if any one should demand why they were such, and whence they had their *Truth*, it might be answered, that they were Eternally so *of themselves*, and that for that Reason, they became the Objects of the *Divine Knowledge*, as being of themselves Antecedent to it. Which is so derogatory to the *Divine Omnipotence*, that it is a wonder to me how any can assert such a thing, who consider well the *Divine Independency* upon any things whatsoever. Forasmuch as it would follow from hence, that the Complement of the *Divine Cogitation* would not depend on the sole understanding of himself, but also of some other thing, which was not of the *Nature* of *God*, and which is conceived as independent on his *Will*.

VI. *In what Sense the Essences of things are said to be immutable and Eternal.*

If you *Object* that the *Essences* of things are *Eternal* and *Immutable*; I answer, That they are so indeed, if it be understood concerning the *Immutability* and *Eternity*, which *God* hath prefixt to them, whilst by his Free-will he has determined some things to be unchangeable. Or else it may be said according to the Sense of the Vulgar, that the *Natures* of *things* are *Eternal*, because there was no Time before them; or rather because the *Eternal God*, doth conceive them without Succession, neither will suffer them for ever to cease or be changed.

VII. *God is the Cause of Truths, as a King is of his Laws.*

GOD therefore is the *Efficient Cause* of all things; not only of such as *Exist*, but also of *Possibles*, and of all *Truths* that we call *Eternal*: In like manner as a *King* is the Maker of all the *Laws* in his *Kingdom*. For all these *Truths* are inborn in us from him; as a *King* also would have them so in his *Subjects*, if he had Power enough to write his *Laws* in their Hearts.

VIII. *Objection.*

If any one say, That this would make *God* inferiour to a *King*, who can at his Pleasure annul the *Laws* he has made; which if *God* should do, those *Truths* would lose their *Essence*, and consequently would be no longer *True* or *Immutable*.

IX. *Answer.*

I Answer, That the Case of *God* and a *King* are very different. A *King* can change his Laws, because his *Will* is changeable, but *God's Will* is unchangeable; for it is his *Perfection*, that he acts in a most constant and invariable manner. Neither doth it hinder this that his *Will* is free; for as his *Will* is free, so likewise is his *Power* Incomprehensible. Wherefore tho' I cannot comprehend how it should not be true, that *One* and *Five* are *Six*; yet I understand clearly enough, that it is impossible there should be any thing in the whole *Universe* of Things, which does not depend on him. And therefore it is contrary to *Reason* to think that any thing cannot be otherwise, because we cannot understand how it can be. It is indeed true in the general, that *GOD* can do all those things, which are clearly and distinctly known by

us; yet doth it not follow from thence, that he cannot do those things that we cannot conceive: For our *Imagination*, or *Understanding*, cannot be the Rule of his *Power*. Therefore we must conclude, That the *Essences* of Things, and *Mathematical Truths* are from *God*, because he so conceived them, so ordered, and so commanded them: According to that of S. *Austin*; *Because thou seest them*, (or rather, because it listeth thee) *therefore they are.*

CHAP. VII.

Concerning the Divine Attributes; and, First, Of the Unity of GOD.

I. *What the Attributes of GOD are.*

ALtho' GOD be One meer *Cogitation*, and all his *Perfections* or *Attributes* indivisibly United; yet the Acts of *Cogitation* that we have of him, stirr'd up from several Occasions, which frequently involve many *Objects*, are Many. For when I consider, that my *Mind* doth not exist of it self, neither can do all, nor understand all things, &c. I turn my self to the *Divine Cogitation*, which comprehends all *Perfections*. And these *Reflexions*, whether as referr'd to *God*, or to the various Conceptions of *Objects*, are called *Attributes*. Whence it comes to pass, that one of my *Cogitations* I have of *God*, as *Existing*, is different from another *Cogitation* I have of him, as *All-powerful*, or *Eternal*: Because the occasions of these my Thoughts are different; and one *Object* which I refer or apply to *God*, is different from another which I can likewise apply to him. Wherefore seeing I do not find my *Mind* to be one only, but perceive also the *Idea's* of other *Minds* of the same Nature with mine, I cast my Eye on the *Divine Cogitation*, and thence take an occasion of considering its *Unity*.

II. *The Divine Attributes are indivisibly united.*

If therefore we consider the *Essence* of *God* in it self, it appears to us to be one *Simple, Uniform Cogitation*, exempt from all *Order*, *Distinction*, *Priority*, or *Posteriority*. Forasmuch as all the *Perfections* that are, or we can think of in *God*, are not only actually present in his *Nature*, and inseparably united with it; but are so intimately joyned, that the one is the other; yea, that one of them is all the rest, and All are most properly One in their *Essence*: So as that his *Eternity* is his *Omnipotence*, his *Life*, his *Spirituality*. In a word, All his *Attributes* are his *Life*, and his *Life* is all his *Attributes*.

III. *The Unity of GOD was known to the Ancients.*

It was the constant Opinion of the *Ancients*, That GOD is One only, the Sovereign of the *Universe*, whom all things obey. Both *Poets* and *Philosophers* own'd this, who frequently call him, *The Maker of all things*, *The Ruler of the World*, and *The Mind diffus'd through all things*. Wherefore also they gave him no peculiar *Name*, as supposing that no *Title* could be given to him, who was singular, and had nothing common with other *things*; for that *Names* were only necessary where Plurality is to be distinguish'd, and persons discriminated by certain Marks.

IV. *The Divine Unity is to be explained.*

But because the word *Unity* is taken in divers *Senses*, we are to enquire first, in what respect *God* is said to be one, before we can come to know, that there can be no more than one.

V. *A thing is said to be One, three several ways.*

A Thing is said to be one, *First*, when its *Parts* are united; yet so as that it may be divided into them; as a *Body* is said to be One, because of the *Union* of its *Parts*, tho' they be separable. Secondly, A Thing is said to be One, because it hath one *single Essence*, which cannot be divided into *Parts*; tho' the *Attributes* and *Modes* wherewith it is diversified, may be separated from it, such as *Knowledge* and *Vertue*, without which the *Soul* of *Man* may be. Thirdly, a *Thing* is said to be *One*, which is so undivided, that it can in no respect be divided, nor hath any *Attributes*, or *Modes*, that are separable from it, but all things appertaining are most simply one.

VI. *How God is said to be One.*

In this last meaning *God* is said to be *One*, because all that is in him is *One*, neither hath he any *Attributes* that are not *Essential* to him, and Inseparable from him. And therefore according to our *Philosophy*, the *Divine Attributes* are only Modes of *Thinking*. For when we distinguish his *Will* and *Understanding*, that distinction is only made by our *Minds*, as we conceive him to be conversant about *Goodness* or *Truth*. But *Real Modes* are found in the Things themselves, which they affect and distinguish from others; as *Figure* and *Motion* in *Bodies*; *Willing* and *Understanding* in the *Mind*. And are therefore call'd the *Modes* of *Things*, because they agree to mutable Things, such as all *Created Beings* are; but not to a *Being* that is constant and ever abiding, such as *God* alone is. Wherefore whatsoever is in *God* is only distinguishable by reason.

VII. *God is one in such a manner, that there can be no more besides him.*

Having shewed what manner of *Unity* agrees to GOD, it may further be queried, Whether *God* be one in such a manner, as to suffer or admit none besides him. To which I answer, That *God* is One in such a manner that he cannot be multiplied: For seeing by the Name, GOD, we understand a most *Perfect Being*, it is necessary that it comprehend all that is most *Real*; so that supposing him to *exist*, all conceivable *Perfection* must be placed in him, so as by his *Idea* and *Essence* formally to exclude every most *perfect Being* besides himself. For indeed how can any be equal to him? Or how can all conceivable *Perfections* be in two several *Subsistences*; seeing that whatsoever admits of *Division* is subject to *dissolution*, which is the most remote from the *Nature* of *God*, who is *Incorruptible* and *Eternal*.

VIII. *Multiplicity of Gods implies a Contradiction.*

If it be said, That this *Division* is no hindrance to their *Immortality*, as long as the one doth not arrogate any thing that belongs to the other, but each of them follow their own work. It will still come to the same thing; for this distribution of their *Work* or *Business*, is an evident Instance of great *Imperfection*; because this supposeth them to stand in need of one anothers assistance, being unable all alone to govern the *World*; which is contradictory to the *Divine Essence*, which is known to be *Omnipotent*, *Infinite*, and *All-wise*.

IX. *If there were more Gods than one, they could not be equal.*

Moreover it is most certain, that supposing a *Plurality* of *Gods*, they cannot be every way equal, but that some *Perfections* would be found in the one, which are not in the other, which is altogether incompetible to the *Supream Being*. For let us suppose two *Gods*, whom for the greater clearness of Discourse, we will call *Saturn* and *Jupiter*. Now these two Gods, forasmuch as they severally include all *Perfections*, they must of necessity be *All-knowing*, so as not only to know themselves, but others also; and because in the *Idea* of either

of

of them, neceſſary *Exiſtence* is included, it will follow, that the Cauſe of the Neceſſity and Truth of the *Idea* of *Saturn*, which is in *Jupiter*, will be *Saturn* himſelf; and the Cauſe of the Truth and Neceſſity of the *Idea* of *Jupiter*, which is in *Saturn*, will be *Jupiter*; and therefore ſome Perfection will be found in *Saturn*, which is not in *Jupiter*; and in *Jupiter*, which is not in *Saturn*. The reaſon whereof is this, becauſe the Perfection of the underſtanding of either of them, will depend on the other; and ſo muſt be both of them Imperfect, which is repugnant to the Nature of a moſt *perfect Being*.

X. *Neither could they be Omnipotent, or All-knowing,* It belongs alſo to the *Idea* of a moſt *perfect Being*, that he be *All-powerful* and *All-knowing*; but it is a Contradiction, that more *Beings* than one ſhould be endowed with theſe *Perfections*: For either they would be able to hide their *Thoughts* from each other, or not be able; if the firſt, how could they both be *Omniſcious*? If the latter, how could they be *Omnipotent*?

IX. *If God exiſt, he muſt be One.* Laſtly, Neceſſary *Exiſtence* is included in the *Idea* of *God*, becauſe he is *Independent* of, and before all other *Beings*. Now whatſoever doth neceſſarily *exiſt*, muſt of neceſſity be Singular, ſince *Singular Being* is nothing, but actually to *exiſt*, which is ſo peculiar to *God*, that he cannot but *exiſt*: Wherefore ſeeing *Singularity* and *Unity* are one and the ſame thing, it is evident that the *Divine Nature* excludes all *Multiplicity*, that is, cannot be divided into more *Gods*; and conſequently, as *God* is *Undivided* in himſelf, ſo neither can he be *partible* into others.

XII. *The Heathens did not own many Gods.* But may ſome ſay, How comes it to paſs then that the *Heathens* worſhip'd many Gods, if it be ſo that more Gods than one implies a Contradiction? I anſwer, That the *Heathens* never had any *Idea* of many *Beings* abſolutely perfect, as is evident from their *Writings*; becauſe they made one to Rule in *Heaven*, another in *Hell*, a third over the *Winds*, a fourth over the *Fire*, and diſtributed the Government of the *Univerſe* amongſt many Gods: But they did not ſuppoſe any of them to contain all manner of *Perfections*, and to have the Power and Dominion over all *Creatures*; but took them to be much of the ſame Nature as we conceive the *Angels*. And *Marſilius Ficinus* tells us as much, *Argument. in Cratylum: Neither let it trouble you*, ſaith he, *that* Plato *doth frequently make mention of many Gods: For he proves in his* Parmenides *and* Timæus, *that there is but One God; and that the reſt are only his Angelical and Heavenly Miniſters; and by calling them Gods, doth not ſo much imply their being Gods, as their being Divine*. For indeed the *Philoſophers* do ſo much abhor a Plurality of *Gods*, that it would be more eaſie to perſuade *Euclid*, that many *Centers* may be found in a *Circle*, than to make *Philoſophers* believe that there are more than one *God* in the *World*.

CHAP. VIII.

That GOD is Eternal, or without Beginning and End.

I. *The Error of ſome, who ſay, that God was the Beginning,* THo' almoſt all *Philoſophers* agree in this, that there is a *GOD*, and that he governs the *World*; yet don't all of them conceive his *Exiſtence* after one and the ſame manner. Some of them are of Opinion, that *GOD* had ſome kind of *Efficient Cauſe of himſelf.* and tho' the ſame were before all Ages; yet that he was born or produced as all other Things. But foraſmuch as it was unbecoming the *Divine Majeſty* to proceed from any other, and that he who is the *Author* of all Good, ſhould derive his *Being* from another, they aſſerted him to be his own *Efficient Cauſe*, and that he ſo proceeded from himſelf.

II. *This Opinion deſtroys the Nature of God.* But this Opinion does not ſo much oppoſe *Reaſon*, as it deſtroys the very *Nature* of *God*: For how could *God* produce himſelf, ſince this ſuppoſeth that before his *Production* he was not, becauſe he was then to be produced, and yet was at the ſame time, foraſmuch as he did then influence his own *Production*, which are abſolute Contradictions. And whatever may be ſaid in this caſe, we muſt allow ſome *Principle* of the *Divine Production*, which is abſolutely repugnant to the Nature of *God*. For we no ſooner conſider the *Nature* of GOD, but we find him to be *the Moſt perfect Being*, which excludes all *Imperfections*, that is, any bounds or limitation of his *Perfections*, and includes all *Perfections*, and conſequently alſo *Exiſtence*, by which he is diſtinguiſh'd from all other things.

III. Neceſſary Exiſtence *is contain'd in the Nature of God.* For tho' whatſoever we conceive be apprehended by us as *Exiſting*; yet we find that *Exiſtence* doth not belong to *God* and the *Creatures* in the ſame manner. For in the Conception of *Creatures*, whoſe Perfections are *finite*, only *Contingent* and *Poſſible Exiſtence* is contained; whereas in the Notion of God, *Neceſſary Exiſtence* is included, as being an *Eternal Perfection*; inſomuch that it is as obvious to our knowledge that *GOD exiſts*, as it is to a *Mathematician*, that a *Triangle* hath three *Angles* equal to two right ones. For as it is the Nature of a *Triangle* to have three *Angles* equal to two right ones; ſo likewiſe it is the Nature of *God*, to be neceſſarily *Exiſtent*, and therefore as he exiſts now, it muſt be acknowledg'd that he hath exiſted from all *Eternity*.

IV. *They who diſtinguiſh God's Eſſence from his Exiſtence, takes away his Eternity.* They who do not mind this, are very liable to Error, and to aſcribe to *God* ſimple *Duration* inſtead of *Eternity*: For by diſtinguiſhing *Exiſtence* from *Eſſence* in *God*, as in other *Created Beings*, they imagine *Succeſſion of Time* to have place in him, and by this means divide that which is *Infinite*, into Parts, and aſſign differences of *Duration* to it. Hence it is that ſome demand, Whether *God* hath not *exiſted* longer now, than when he firſt Created the *VVorld*; or whether he did not *exiſt* longer before the *Creation* of the *VVorld*, than the Time that has run from the *Beginning* of the *VVorld* till now. Which *Queſtions* are occaſion'd by their ſeparating the *Eſſence* of God from his *Exiſtence*, and ſuppoſing that the *Eternity* of God may be underſtood, without the contemplation of his *Eſſence*; or becauſe they have not diſtinguiſh'd *Duration* from *Eternity*, but have concluded them to be confounded together. For *Duration* is an *Attribute* of the Exiſtence of *things*, not of their *Eſſence*. Who will not ſay that the Propoſitions, *Twice three make ſix*; *Nothing is made out of Nothing*; which are only ſaid to be true according to their *Eſſence*, that they have continued longer now than at any other time? Wherefore *Duration* is only an Affection of *Exiſtence*; whereas *Eternity* cannot be conceived without the *Divine Eſſence*; and foraſmuch as the *Exiſtence* of God is contain'd in the Conception of his *Eſſence*, we are alſo to attribute *Eternity* to him, and not *Duration*.

V. *The Nature of God includes no Conception of Futurity.* Therefore we say, that all Creatures *Enjoy* Existence, forasmuch as it doth not belong to their *Essences*, but is in a manner foreign to them. But this cannot be affirm'd of *God*, because his *Existence* is not distinct from his *Essence*, and is GOD himself. Besides, all *Creatures*, whilst they *enjoy* the present *Time* and *Existence*, may be said to have it *to come*, forasmuch as their *Existence* is without them, and only successively bestowed upon them: Whereas we cannot say of the *Divine Existence*, that it will be, or is to come, because he has now the same *Existence* he will have for ever; *Actual Existence* in him being like all his other *Attributes*, which denote no difference of *Time* in Him.

VI. *Whether the Mind of Man hath a permanent Existence, as God hath.* It may be Objected, That some *Philosophers* and *Divines* hold, that the *Duration* of the *Mind* of Man is Permament, and as they express it, *All at once*, and ye none of them attribute *Eternity* to it: So that accordingly, tho' the *Existence* of God have no Parts whereof some are before the other; yet for all that *Duration* may be attributed to him.

VII. *An Answer to this Doubt.* I answer, That *Permanent Duration* can only improperly be attributed to the *Mind* of Man, because we find a manifest *Succession* in our Thoughts, whereof nothing is to be found in the *Divine Perception*. But to explain my Mind more fully, I think that *Permanency* is very improperly attributed to *Creatures*, forasmuch as the most Perfect of them, cannot all at once admit all the *Attributes* and *Modes* it is capable of. For as it implies a Contradiction for a *Body* at one and the same time to admit several Figures, as to be *Square* and *Round*, to *Move* and *Rest*, so neither can a *Created Spirit* affirm and deny the same thing, or comprehend all those things with one *Thought*, which it is capable of knowing. But GOD possesseth all *Perfections*, and all *Attributes*, at one and the same time, neither is any of them before or after the other. And therefore *Permanence* appertains only to GOD, and *Duration* to all other *Beings*. Besides, since all *Creatures* are Created by *God* with equal dependency, and have their *Preservation* no longer than he pleaseth to continue it; it follows, that their Duration is not *permanent*, but *successive*, and can indeed be nothing else but a continual *Reproduction*, by which they persevere in their *Beings*.

CHAP. IX.

That GOD is Infinite, and how we are to understand, that he is Circumscrib'd in no Place.

I. *All things are not contain'd in some place.* AMongst those Prejudices, which we have taken in from our *Childhood*, and which some to this day hold for Truth, there is none more dangerous in *Philosophy* than that which *ARISTOTLE* teacheth in the *Fourth Book* of his *Natural Philosophy*, the *First Chapter*, viz. *That all things are somewhere*, that is, contained in some certain Space; because he supposed *whatsoever is not, to be no where*; which he takes to be so notorious and evident, that he is not afraid to rank it amongst *Common Notions*, and to esteem it an indubitable *Truth*. Wherefore also in his *First Book of Heaven*, the *Third Chapter*, he assigns the Highest place to the *Gods*, as most becoming their Dignity, and whence with greater ease they may take a View of all Things. And in the same Book, *Chap.* 2. he disputes against the most ancient *Philosophers*, and denies *God* to be diffus'd through all Things, as supposing it most unworthy the *Divine Majesty* to be present with the Earthly World.

II. *Immaterial things cannot be said to be in a Place.* But that this is an Erroneous Opinion, appears from the *Immensity* of GOD, and the *Existence* of *Spiritual Things*: For it is evident that *God* and *Immaterial Substances* are, or have a *Being*, and yet they are not comprehended in any determinate Place. For to be in a *Place* is the Property of *Extended Beings*, and cannot be attributed to an *Immaterial Substance* void of all *Extension*. If at any time *Places* be attributed to the *Soul*, this is not with respect to its own Essence, which consists only in *Cogitation*, but with respect to the *Body*, to which it is joyned; because it cannot be, but that the *Body* being limited to a certain Space, the *Soul*, which is intimately present with it, may be said to be included in one place, rather than in another. But if the *Soul* be considered by it self alone, forasmuch as it is a *Thinking Substance* and void of all Extension, it cannot fill any Space, nor have any situation amongst *Bodies*; for otherwise it would be Divisible and Mensurable, which is repugnant to the Nature of an *Intellectual Being*.

III. *God is comprehended in no Place.* And as for GOD, he is much less comprehended in any Place: For tho' he be said to be *every where*, yet may he also be said to be *no where*; forasmuch as his *Immensity* is unbounded and diffus'd through all Places. But because all do acknowledge, that the most *Perfect Being* hath no Bounds, either of his *Duration* or his *Presence*, the only difficulty will be in the Explication of the *Divine Immensity*, *viz.* in what sense *God* is said to be *Infinite*, and so diffused through all, as to be *every where*.

IV. *Some falsly suppose God to be every where by his Presence.* Some, whom I call *Vulgar Philosophers*, derive the Immensity of *God*, from his *Presence* in every place, supposing *God* to be every where, because there is no place in which he is not present, or which is not filled by him. But these seem to Attribute *Extension* to *God*, by conceiving to partake of *Quantity*, as Occupying all *places*: And therefore would think his Greatness to be *Finite*, if there could be any place, in which he were not present, and coextended with it.

V. *God, before the Creation of the World, was not in any Space.* Whereas we know that *God* was, before there was any *Space*; for what *Place* did *God* fill before the *Creation* of the *World*? If *God* therefore did Exist before there was any *Space*, it is evident that being in a Space is not *Essential* or Proper to him.

VI. *God is said to be* every where, *because all Created things perpetually depend upon him.* Wherefore to leave this gross way of *Philosophizing*, we say, that *God* is precisely *Infinite*, forasmuch as all *Created things*, are every moment as it were anew *Created*, and cannot Exist without his continual Influx: For the perpetual dependence of the *Creatures*, doth clearly Evidence *Gods Omnipresence*; because those things which are in Nature, are not preserved by any Force or Virtue of their own, but only by the *Essence* of *God*, and by his Favour continue in their *Beings*. Neither is a less potent Cause required to the *Preserving* of things, than was to the *Creation* of them. For from this that a thing now *Exists*, it doth not follow, that

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it ſhall *Exiſt* the next moment, ſince there is no neceſſary Connexion of the Parts of time, but one of them is alway diſtinct from the other; ſo that *God* muſt influence his *Creatures* in the ſame manner for their Conſervation: In which Conſervation, and preſence in every thing, the *Immenſity* of *God* doth conſiſt. Thus *God* is ſaid to be preſent to our *Minds*, becauſe he is with every one of our *Thoughts*, and concurs to every determination of our *Wills*. And he is ſaid to be preſent to our *Bodies*, becauſe he doth diſpoſe, move and make them reſt. Laſtly, he is preſent to all *other things*, becauſe he doth as it were continually produce them anew, cheriſhing and preſerving them by a way that ſurpaſſeth our Underſtanding.

VII. *God is not preſent every where by his Power, but by his Eſſence.*

Neither can I aſſent to thoſe who ſay, that *God* is preſent every where, not by his *Eſſence*, but by his Power only, by which they ſeem to divide his Power, from his *Eſſence* and other *Attributes*; whereas indeed all things that are in *God*, are one with his *Eſſence*; nor are his *Attributes* any thing elſe, but divers *Modes* of *Thinking*. For they muſt be fain to confeſs that this *Power* is ſomething that is *Created*, or ſomething that is only accidentary to the *Divine Eſſence*, without which he may be underſtood or conceived. Now it is the moſt abſurd thing to make it a *Creature*, ſince whatſoever is *Created* doth ſtand in need of the *Divine Power* for its *Exiſtence*; and ſince this *Divine Power* it ſelf is ſuppoſed to be a *Creature*, it will ſtand in need of ſome other Power to preſerve it, and by this means we ſhall make a Progreſs to *Infinity*. Or if they will rather make this *Power* to be accidental to *God*, and diſtinguiſht from his *Eſſence*, then they muſt be forced to admit, that *God* is not a moſt *Simple Subſtance*; becauſe, according to their ſaying, he would be compounded of his *Eſſence* and that *Power*. Wherefore we conclude, that *God* is preſent to all things by his *Eſſence*, and that he is in every *Place*, foraſmuch as he continually procreates and conſerves the things which he hath *Created*.

VIII. *The Immenſity of God is only an External Denomination.*

Hence we may perceive the falſe way of *Reaſoning* uſed by the *Peripateticks*, who to make out the *Doctrin* of *Gods Immenſity*, have invented immaginary *Spaces*; as if the Immenſity or Omnipreſence of *God* were any thing elſe, but an Extrinſecal Denomination, taken from his *Works*; foraſmuch as he *Works* in all *Created things*, and by Reaſon of that Operation is ſaid to be preſent with them. For *Immenſity* in *God*, ſeems to have ſome Affinity with *Creation*; and as *Creation* is Attributed to *God*, from the *Action* of *Creation*, ſince before the *Creation* he could not be called a *Creator*: So likewiſe *Immenſity* is Attributed to *God*, with reſpect to his *Creatures*, ſince he could not be preſent with them, before they were Created.

CHAP. X.

That God is the moſt Simple Being.

I. *What Compoſition is, as it is oppoſed to Simplicity.*

AS things are more clearly and diſtinctly perceived by comparing them by their contraries; ſo I ſuppoſe it will be of great uſe for the Explaining of the *Simplicity* of *God*, to unfold what *Compoſition* is, and to what diſtinction of parts it anſwers. Now *Compoſition* is the *Coalition* or *Union* of many things, which preſuppoſeth a diſtinction of *Parts*, ſince nothing can be united to it ſelf, but to another. And it is various according to the diverſity of the *Parts*, of which things are compounded.

II. *There is a three-fold Compoſition Real, Modal and that of Reaſon.*

For one *Compoſition* is *Real*, which conſiſts of *Parts* really diſtinct; as a Man is compounded of *Soul* and *Body*, becauſe we can clearly and diſtinctly perceive the *Mind* without the *Body*, and the *Body* without the *Mind*. Another is *Modal*, which conſiſts of a *Subject* and *Antecedent* or *Mode*; as a *Prudent Man* is compounded of a *Man* and *Prudence*; and is known by this Mark, that tho' a *Subſtance* may be clearly perceived without the *Mode*, by which it is diverſified; yet on the contrary, the *Mode* cannot be clearly underſtood without the *Subject*, whoſe *Mode* it is. The third ſort of *Compoſition* is called, a *Compoſition* of *Reaſon*, which conſiſts of the *Genus* and *Difference*, as when Man is ſaid to be compounded of an *Animal*, and *Rationality*. Which conſiſts in this that we cannot perceive a thing clearly, if its *Attribute* be excluded from it: As *Extended Matter* or a *Body*, is ſaid to differ only by Reaſon from *Extenſion*, becauſe we cannot conceive a *Bodily Subſtance*, if Extenſion in Length, Breath and Depth be ſeparated from it. And therefore, ſuch kind of *Attributes* as theſe are not called the *Modes* of *Things*, but only *Modes* of *Thinking*, foraſmuch as by the help of *Reaſon* only, they are diſtinguiſht from thoſe things, with reſpect to which they are ſo called.

III. *God does not conſiſt of Parts*

Theſe things preſuppoſed, it will not be difficult to ſhew that *God* is no *Compound*, that is, that he hath no Parts that are Really or Modally diſtinct from each other. For there is no more certain *Argument* of a real Diſtinction, than that the *Idea* of one thing is perceived, not to be the ſame with the *Idea* of another thing; or to ſpeak in *School Terms*, that the one can Exiſt without the other: But it is manifeſt, that no ſuch diſtinction is to be found in *God*, foraſmuch as all his *Attributes* are Eſſential, and not Separable from him, but by the Operation of our *Mind*.

IV. *Nothing in God is before other, and therefore no Compoſition*

Moreover the things that go to the making up of any Compound, muſt at leaſt by *Nature* be before the thing Compounded, or that is made up of them: Thus every *Cauſe* is ſaid to be before its *Effect*; *Subſtance* before *Accidents*; and *Subjects* before *Adjuncts*: And therefore thoſe *Subſtances*, by the Union of which *God* is ſuppoſed to Exiſt, muſt of neceſſity have been before him, ſince we underſtand them to be, before they conſtitute the *Divine Eſſence*. Thus *Matter* and *Form*, which are conſidered in *Natural Philoſophy*, as the two *Principles* of a *Natural Compound*, are apprehended to be, before they do conſtitute their *Compound*. And in like manner, if really diſtinct *Subſtances* were found in *God*, they would be intelligible to us, before that they were *Attributed* to him; yea tho' they ſhould never be *Attributed* to them.

V. *God is not Compounded either of Corporal or Spiritual Parts.*

And foraſmuch, as we aeknowledge only two general heads of things, *viz.* *Material* and *Spiritual*, we muſt of neceſſity ſuppoſe, that the things of which *God* ſhould be compoſed, muſt be Corporal or Intellectual. If the firſt, it will follow, that ſeeing a *Body* is the immediate Subject of *Local Motion*, *God* is Diviſible and Limited, yea, Subject to *Paſſion* and *Alteration*, all which include Imperfection, and conſequently are repugnant to the *Divine Nature*. If they be ſuppoſed to be *Spiritual*, ſince there is a real diſtinction be-

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tween them, and one of them according to the *Rules* of *Logick*, can Exist separate from the other, consequently there will be as many *Gods* as there are *Substances*, that are supposed to constitute *God*. For seeing they can Exist by themselves, and need no assistance from any other to their Conservation, they will also have power to confer upon themselves all the *Perfections*, which belong to *God* alone. Than which nothing more absurd can possibly be imagined by the *Mind* of *Man*.

VI. *There are no Modes in God, out of which he may be said to be compounded*

We say therefore, that there are no *Substantial Parts* in *God*, into which he can be divided, or from the Union and Coalition whereof he doth consist. Neither is there any *Composition* in *God*, out of a *Subject* and *Accidents* or *Modes*; because *Modes* arise only from the various *Change* of the *Substance*, which therefore cannot be supposed in *God*, because in him there is no Change or Variation. Wherefore it follows, that whatsoever is in *God*, is only distinguishable by our *Thoughts*, because every *Attribute* of *God* may be called his *Essence*, and have the name of supreme *Perfection*: And therefore are neither more nor less than the one *God*, in the Unity of Nature. So that we must conclude *God* to be the *most simple Being*, utterly devoid of all *Parts*, or *Divisibility*.

CHAP. XI.

God is true, and as he cannot be deceived, so neither can he deceive.

I. *If God was not true, we could not be assured of any thing.*

THo' *Human Cogitation* be commonly held to be the *Rule* of *Truth*, and whatsoever, we clearly and distinctly perceive, is supposed to be true; yet all this certainty would come to nothing, if *God* were not true, and most remote from the least suspicion of deceiving us: For how should we believe *Revelation*, if it were possible for *God* to deceive us? For he having bestowed upon us our Intellectual Faculties, it might be questioned, whether it was not his pleasure to make us such, as that in the use of them, we should be deceived, and against our will fall into Error.

II. Truth *is a necessary Ingredient of a Being absolutely Perfect.*

But this Doubt will be easily removed, and the *Divine Veracity* cannot but be manifest, by considering that all Perfections that can be conceived by us, do belong to *God*. For, forasmuch as he is the *Highest Being*, he must also of necessity, be the most Soveregin *Good* and *Truth*: Now it is as much a Contradiction, that any Falsity should proceed from the *Highest Truth*, as that any *Evil* should come from the *Highest Good:* Which yet would be, if in the use of our Faculty of knowing, that is, in assenting to things that are clearly and distinctly perceived by us, we should fall into Error. And indeed seeing that whatsoever is real in us does proceed from him, and that the Faculty we have for the knowing of *Truth*, and distinguishing it from *Falsehood*, is Real, we could not but take him for a Deceiver, in case our Faculty could not reach the *Object*, but should always take *Falsehood* for *Truth*. Than which nothing can be imagined more injurious to the most *Perfect Being* and the *Fountain* of all *Good*.

III. *That the Most Perfect Being*

Besides by the *Name* God, we understand the most *perfect* Substance; and Imposture or *Deceit* is a manifest *Imperfection*, because it has a *non-Entity* for its End, that is, something that is not true; for all Deceit includes Falsity, which being oppos'd to Truth, it must be carried to that which is no Truth, that is, a *non-Entity:* So that from hence it will follow that God cannot without a contradiction be said to deceive us. *should deceive us, implies a Contradiction.*

IV. Deceit *is an Argument of* Fear *or* Malice.

Lastly, Tho' perhaps amongst *Men*, it may be accounted a piece of Cunning to deceive others, yet *Falseness* or a *will* to deceive others, proceeds from *Fear* or *Malice*: And forasmuch as *Fear* supposeth Weakness, and *Malice* the want of Goodness, neither of these can be admitted in God; and consequently neither can a Will to deceive be ascribed to him; yea, he must be supposed to be the *Highest Truth*, and not thought a Deceiver upon any account whatsoever.

V. *An Objection from the Concourse of* God.

You will object that he who concurs to those *Actions* of the *Will*, or those *Judgments* by which a *Man* is deceived, he is to be looked upon as the Cause of that *Man's* Error: But God so concurs to those *Judgments* of *Men*, by which they are deceived; therefore God is the cause of *Men's Errors*.

VI. God *doth not concur to the Formality of* Error.

This Objection is easily answer'd by distinguishing between the *Material* and *Formal*, or between an *Act* and its *Privation*. For all *Acts* are true and Good, forasmuch as they depend on *God*; and as it is a greater Perfection in *Man*, that he can exert them, than if he could not. But *Privation*, wherein alone the Formal Reason of *Falsity* doth consist, doth not stand in need of any *Divine Concourse*, because it is No thing, and with Relation to *God*, is not to be call'd a *Privation*, but only a *Negation*.

VII. *Whether* God *may be said to deceive the* Devils *and* Damned Souls *in* Hell.

I know that some *Divines* seem of a different Opinion, who think that *God* can deceive *Men*, by inspiring them with *Idea's* that deceive them; and that he does this of his free Will, as being the Supream Lord of all, and therefore may deal with his *Creatures*, as he listeth. So as that they are clearly persuaded that they feel something, which indeed they do not, according as it happens to the *Devils* and *Damned Souls*, who think they are tormented with *Fire* in *Hell*, when indeed there is no *Fire* there at all; or if there be any, it is Material, and so cannot affect *Pure Minds*.

VIII. *The foregoing Doubt answer'd.*

I Answer, That GOD does not deceive, or by false Apparitions delude the *Devils* or *Damned Souls*; because the *Fire* wherewith they are tormented, is not only an *Idea* of *Fire* impress'd on them by *God*, but the true substance of *Fire* wherewith they are tormented, and sensibly affected. For why may we not suppose, that *God* can joyn the *Soul* of *Man* with some *Body*, and so unite his *Thoughts* to the Motions of that *Body*, that according to the greater or lesser force of the one, a greater or lesser sense of *Pain* may be excited in the other? For as we see that the *Soul* of *Man* is kept link'd to the *Body*, so it may as well, by the *Divine Power*, be detained and suffer by *Corporeal Fire* (as we suppose that in *Hell* to be) seeing that this is consonant with the *Scripture*, and establisheth the *Truth* of GOD.

IX. *In what sense God is said to* Blind the Minds of Men.

If any one urge further, That GOD doth sometimes harden the *Hearts* of *Sinners*, and so blind their *Minds*, that they contemn his *Commands*, and run headlong into the greatest *Sins*, as appears by PHARAOH, whose *Mind* the LORD did so incline to *Evil*, that it was not in his

his Power to obey his *Precepts*. Besides, we read in *Scripture*, That GOD put the *Prophets* upon foretelling Things that did not come to pass; as appears from the History of *Jonah* the *Prophet*, who declar'd from *God* to the *Ninevites*, that their *City* should be *destroyed within forty days*, which never came to pass.

II. X. *Answer.* I Answer, That tho' *Pharaoh*, by the Perverseness of his Will did refuse to obey *God*, and to dismiss the *Children* of *Israel*, notwithstanding the frequent Warnings he had had from above; yet is not this so to be understood, as if *God* by any positive Influx had hardened his *Heart*, and forced him to despise his Commands; but only that he withheld *Efficacious Grace* from him, and left him to his own wicked Will. And as for *Jonah*, who foretold the ruin of the City *Nineveh*, that is not to be called a Lye, but rather a Threatning or Denunciation, the Execution whereof depended on their Obstinacy or Conversion, as appear'd by the Event: For the *Ninevites Repenting* in *Sackcloth* and *Ashes*, and earnestly deprecating the *Divine Displeasure*, did escape the *Prophet*'s Commination.

XI. God *may sometimes deceive us for our Good.* Tho' it be a most undoubted *Truth*, that it is repugnant to the *Divine Perfections* to deceive any one; yet this does not hinder, but he may make use sometimes of a Prudent Deception towards us for our profit, in like manner as *Physicians* and *Parents* sometimes deceive their *Patients* and *Children* for their good and advantage. Neither can *God* properly be said to deceive us, when things appear to us otherwise than they are; because *God* is not the cause of that Deception, but we our selves, who judge of *Bodily things* according to their *External appearance* before that we have sufficiently examin'd them; forasmuch as in these and the like Appearances we should suspend our *Judgment*, before we do determine any thing concerning their *Truth*.

XII. *We cannot be said to be deceiv'd, when we imagine the* Sun *to move, and the* Earth *to stand still.* Thus GOD cannot be said to deceive us, when by the *Earths* whirling about its *Axis*, the *Sun* seems to us to rise and set; but we rather deceive our selves, when we attribute *Motion* to the *Sun*, and *Rest* to the *Earth*, before we have fully discuss'd the Point: When indeed we ought to suspend our *Judgment* until having weighed the Reasons on both sides, we did clearly and distinctly perceive, to which of these *Bodies* the motion we perceive were to be ascribed. Neither are the *Common People* look'd upon to be absolutely in an Error, when they suppose the *Sun* to move every day about the *Earth*, tho' it be not true, because herein they follow what seems probable, which is sufficient to free them from the imputation of being deceived.

XIII. *From God's Veracity we may conclude, that whatsoever is clearly perceived by us, is true.* Hence it follows, that whatsoever is clearly and distinctly known by us, is true: For since the Light of *Nature*, or our Faculty of *Knowing*, hath been given us by *God*, it can reach no *Object* which is not true, so far as it is reached by it; that is, forasmuch as it is clearly and distinctly perceived. For *God* might with reason be look'd upon as a Deceiver, in case he had given us a Faculty that embraced *Error* instead of *Truth*: Wherefore forasmuch as *Mathematical Truths* are most clear and evident, so as to thrust themselves upon our *Understandings*, we ought not in the least to suspect them, but receive them as undoubted *Truths*.

CHAP. XII.

That GOD *is most highly Intelligent, or Omniscient.*

I. Omniscience *is included in the Conception of a most Perfect Being.* IT will not be any hard matter to make out, that GOD is *Omniscient* or *All-knowing*, and that at one view he comprehends all things, if we remember him to be the *Most perfect Being*, in whom no defect or limitation can be conceived, which would not be if his *Knowledge* were finite, and that any thing could escape his *Understanding*. Therefore the *Ancients* called GOD, the *Mind*, or *Soul of the World*; not only for that he was diffused throughout the Universe, and did animate all Things; but also because he knows them all, and pierceth their most Secret parts. For *Ignorance* is a mark of Weakness of *Soul*, and that *Being* cannot but be Imperfect, whose *Understanding* is bounded by any Bound or Limit, beyond which it cannot reach.

II. *This Point further made out by Reason.* But because *Discourse* and *Reason* serve to illustrate the *Truth* of Things, I shall make use of this Argument: Either GOD understands *all things*, or *some things* only, or *nothing at all*. If he only understand *some things*, then his *Understanding* is supposed imperfect, which no body will say of *God*, that is persuaded of his absolute *Perfection*. But if he knows *nothing*, then certainly he cannot be supposed to be *God*. Wherefore it follows, that as *God* contains all *Perfections*, so he is endowed with *knowledge* in the highest and most transcendent degree.

III. *How the* Divine Knowledge *is distinguish'd from the* Knowledge *of Men.* I say, in the most transcendent degree, because *Human Cogitation* is very different from the *Divine*. For the *Idea's* of *Men* are bounded by the *Objects* that are without them, and according to the diversity of things which it contemplates, are said to be either *clear* or *obscure*. For it does not depend of us, that our *Idea's* do represent this or the other thing to us, they being only *Modes* of *Cogitation*, and as such are all of them equal, all their difference proceeding from the *Objects* they represent; so that some hold forth to us an *Extended Substance*, others a *Mind*; some *Simple things*, others *Compound*; all which variety the *Idea's* borrow from the Things themselves. For it cannot be question'd, but that those *Idea's* which represent some *particular Substance* to us, contain more *objective Reality*, than those which only exhibit *Modes* to us, which are only the determinations or limitations of *Substance*. But the *Divine Knowledge* doth not thus depend on the *Creatures*, neither are his *Conceptions* bounded by any things without him; but all *Created Beings* derive their *Essence* from his *Understanding*, and according as they are determin'd by the same, do obtain divers degrees of *Entity*. For the *Divine Intellect*, whereby *God* knows the *Creatures*, is the same thing with his *Will* and *Power* that does determine them, and are only distinguish'd by us, according to our various ways of considering them.

IV. *There is no Object of* God's *Knowledge, that is without himself.* Wherefore we are not to suppose any Object of the *Divine Science* to be without himself, who is alone the Object of his own *Knowledge*; or to speak more properly, He is himself his own *Knowledge*. For should we suppose, that *Created Beings* were before the *Divine Intellect*, and that as Objects they did terminate his *Idea's*, they must be supposed to have a *Nature* and *Essence* independent

on *God*, as being at least by *Nature* before him. Which to assert would be as foolish, as to say that a *Pourtraiture* drawn by a Skilful *Limner*, is the *Object* of that Art: For a *Limner* stands in need of *Pencils* and *Colours*, to perform his *Work*; whereas GOD did not stand in need of any thing for the *Creation* of the *World*, but all *Created things* did proceed from his *Understanding* and *Free Will*; not only as to their *Existence*, but as to their *Essence* also.

V. *Indifferency in God is the Highest Perfection.*

Whence it appears, that *Indifferency* which is an Imperfection in Man, and is held to be the lowest degree of his *Liberty*, is the *Highest Perfection* in *God*, as being a sign of his *Sovereign Empire* and *Power*, who is unbounded by any *Laws* or *Rules*, and the sole *Author* of all *Order*, *Truth*, *Justice* and *Goodness*. For it implies a Contradiction, to suppose that the *Divine Will* was not indifferent to all things, that have been or shall be made. Because no *Goodness* or *Truth* can be imagined, the *Idea* whereof was in the *Divine Intellect*, before that his Will had determined to make it so.

VI. *How God knows Sins, and those things which are called* Entia Rationis. *Entities of Reason.*

Some Question whether the *Divine Knowledge* doth extend it self to all things, and whether *God* besides Positive things, that is, real *Substances*, doth also know things Privative and Fictitious, such as are *Sins*, *entities of Reason*, &c.

VII. *Answer.*

For Answer I say, that *God* knoweth all things whereof he is the *Efficient Cause*, because as was said in the Chapter of *Gods* Immensity, all things are continually procreated by him, as not being able to continue one Moment without his Concourse: But *Sins* being no real things, and depending on the *Will* of *Man*, are not known by him without the *Minds* of *Men*. And as for *Entities* of *Reason*, forasmuch as they are nothing else but *Modes of Thinking*, which are used for the easier Explication of the *things* we know, or the better retaining of them; these are no otherwise understood by *God*, than as he is the Procreator and Conservator of our *Minds*. For if we enquired what is meant by an *Entity of Reason*, we shall find it to be a *meer Nothing*, without the Understanding. But if we have regard to the *Modes* themselves of *Thinking*, they may be said to be *real Entities*. Thus, when I enquire what is *Genus*, I demand nothing else but the Nature of that *Mode* of *Thinking*, which is truly considered as a *Being*, and differs from a *Species*, which is another *Mode* of *Cogitation*.

VIII. *God understands Entities of Reason only forasmuch as they are conceived by us.*

Now *God* doth not contain any of these *Entities* of *Reason* or *Notions*, as if he stood in need of these *Modes* of *Cogitation*, to retain the things that he understands; but only inasmuch as the *Mind* of *Man*, whose *Modes* they are, is perceived by us to be preserved and maintained in its *Being* by *God*. We conclude therefore that *God* is *All knowing*, and that he contemplates all things by one only most Simple *Idea*; for to speak properly, *God* for no other Reason is called *Omniscient*, but because he has his own *Idea*, which being nothing else but his *Essence*, is therefore inseparable from him, and consequently extends it self to all positive or real Objects.

CHAP. XIII.

That God is Good, and doth Good.

I. *In what Sense God is said to be Good.*

SEeing that no *Creature exists* by its own *Power*, and that all thing derive their *Essence* from *God*, we must conclude that *God* is *Good* and *Beneficent*. For as by his comprehending all things he is *All-knowing*, and by his Power to do all things, *Omnipotent*: So because he hath *Created* all things, he is said to be *Good*, and because he preserves the same, *Beneficent*.

II. *Good and Evil are Respective Terms.*

This will more clearly appear, if we consider what *Good* and *Evil* is, and wherein precisely the *Nature* of both doth consist. A thing considered by it self apart, cannot be said to be *Good* or *Evil*, but is denominated such with respect to an other thing, to which it is profitable or hurtful. And accordingly, the same thing may at the same time, be said to be both *Good* and *Evil*. So the *Punishment* inflicted on a Criminal is *Good*, forasmuch as it conduceth to the Safety of the *Commonwealth*, and to deter others from committing the like *Crimes*: And yet it is *Evil* to the *Criminal*, because by the same he suffers Death, which deprives him of *Life*, being the dearest thing he enjoys. So likewise the *Sea* is of great use for the carrying of *Ships*, and in that regard is a *Good* to the *Merchants*; but *Evil* when raging by a Storm it Swallows and *Shipwracks* their *Vessels*. Yea, there be many Good things, which are not such to all: Thus, to be in *Heaven* and to enjoy the company of the *Blessed*, is a Good, yea the greatest Happiness to Man, but yet to *Brutes* and *Plants* it is neither *Good* nor *Evil*, as having no Relation to them.

III. *God is said to be Good, as being beneficial to all.*

GOD therefore is said to be supremely *Good*, because he does *Good* to all, and is the Conservator of all things, for all things are preserved by his *Omnipotence*. Moreover, forasmuch as there is no Connexion between the parts of *Durations*; and it doth not follow, that because the *Creatures* exist to day, they will continue to morrow: We may say that *Gods* Conservation of his *Creatures*, is a continual production of them. Neither doth it oppose this *Truth*, that the Will of Man is free, and is oft determined by things without it: Because even those very Actions are determined by *God*, and are not exerted but by his Good-will, as will be said more at large in the following Chapter. For it implies a contradiction, that any thing should determine the *Will*, and that the *Will* it self should not be determined by *God*, to whom all created things are Subject.

IV. *The Love of God to Mankind is from Eternity.*

Gods Beneficence doth not only appear in the *Creation* of the *World*, and the preserving of all *Creatures*; but he hath also from *Eternity* testified his *Love* unto us, by electing us from before the Foundation of *World*, and by loving us with an *everlasting Love*. For as *Heat* cannot but warm, and *Light* illuminate, so the highest *Love* cannot but in he highest degree love it self, and all things proceeding from him. And this *Eternal Love* of *God* is manifested by a two-fold effect, *viz.* the *Mortal Life* we *Live* here, and the *Immortal Life* we hope for, hereafter. With reference to the present *Life*, he hath adorned the *Heaven* with *Stars*, that they might assist inferior things with their *Light*, and promote the innumerable Generations of *Natural things*; he hath distinguisht the *Elements* in their proper Place, endowed them with *Qualities*, and made them by their inborn *Virtues*, to concur to the Mixtion and Production of all things; he hath appointed the *Fire* for Action, the *Air* for Respiration, the *Water* and *Earth* for Fruitfulness, and the Production of so many *kinds* of *things* for necessity and delight, but the chiefest Pledge of *Gods*

Love

Love towards us; is, that he hath predeſtinated us to the Adoption of *Children* in *Chriſt Jeſus*, ſo as that we have *Redemption* by his *Blood*, and the *Forgiveneſs* of *Sins*, according to the *Riches* of his *Grace*. *For* Grace *hath preceded* Merit; *neither doth* Grace *come from* Merit, *but* Merit *from* Grace. *He gave for Nothing, or out of meer* Grace, *who found Nothing why he ſhould Save, and Much why he ſhould Damn: He prevented us by the Bleſſings of his* Sweetneſs; *for that* Grace *taſtes ſweeter, which helps even thoſe that have ill-deſerved, and entertains Thoughts of* Peace *towards us, whilſt we do the VVorks of* Death. S. *Auſtin*, Serm. 15. de verb. *Apoſt.*

VI. *God is ſaid to be* Good *and* Infinite, *reſpectively onely.*

But you will ſay, What ſhall not GOD be good then, except he do Good to *Mankind*, and preſerve the *Univerſe*? What can be imagin'd more abſur'd, than not to acknowledge *GOD Good*, as well as *Immenſe*, *VViſe*, and *Powerful*?

Notwithſtanding this Objection, we muſt aſſert, That the *Attribute* of *Goodneſs* did not belong to *God* before the *Creation* of the *VVorld*; becauſe a Thing conſidered in it ſelf, and without reſpect to others, cannot be ſaid to be either *Good* or *Evil*: Neither needs this ſeem ſtrange or abſurd to any one, foraſmuch as the *Goodneſs* we ſpeak of here, denotes a Reſpect between *God* and his *Creatures*, as his *Immenſity* does, which conſiſts, as we have ſeen, in that Operation whereby he continues them in *Being*. So that as ſuppoſing they were not, tho' he would be preſent to Himſelf; yet *Ubiquity*, or *Omnipreſence* could not be attributable to him; ſo before the *Creation* of the *VVorld*, tho' GOD be *Good* by his own *Eſſence*, yet becauſe there was nothing on which he could exerciſe his *Beneficence*, he was only *Potentially Good*, *Merciful*, a *Judge*, a *Creator*, *&c.*

VII. *How it coms to paſs that God being Good, permits* Sin.

But ſome will ſay, If GOD be *Good*, why doth he permit the Corruption of *Nature*, and the *Sins* of *Men* to offend his *Divine Majeſty*?

VIII. *The Firſt Anſwer.*

To which I Anſwer, Firſt, That it is not repugnant to the *Divine Goodneſs* that there are *Sins*, and that *Men* ſwerve from their *Duty*; yea, it ſeems more to comport with his *Omnipotent Goodneſs* to bring *Good* out of *Evil*, than not to ſuffer *Evil*. But yet it is not our buſineſs to enquire overcurioufly, why *God* permits *Sin*, leſt we ſhould ſeem to endeavour with the ſcanty Line of our *Reaſon*, to fathom the depth of the *Divine Wiſdom*.

IX. *The Second Anſwer.*

In the Second place I Anſwer, That it is not contrary to the *Divine Goodneſs*, that he hath not made his *Creatures* ſo perfect, as to place them out of the reach of *Error*, or danger of *Falling*; and that he hath pitch'd upon ſuch an Order, in which *Sins* take place; foraſmuch as *Man Sins* without any force put upon him; neither can the Guilt of it be imputed to *God*: For *God* did not from Eternity decree *Sin*, neither did he decree, that *Sin* ſhould be poſſible; for ſeeing *Sin* is no poſitive thing, but a deficiency of *Reality*, it cannot be of *God*, but he only hath eſtabliſhed that Order, in which he ſees the poſſibility of *Sin* before his *Decree* and *Will* concerning it. And therefore upon this *Hypotheſis* only it follows, that having eſtabliſh'd ſuch an *Order*, and making poſitive Things poſſible, he can be ſaid the *Author* of *Sin*; foraſmuch as by the ſaid Order, *Sin* is made Poſſible, which in this ſenſe is not repugnant to the *Goodneſs* and *Holineſs* of GOD.

CHAP. XIV.

Of the Omnipotence of GOD.

I. *It is an inborn Notion with all Men, that God is* Omnipotent.

NO *Man* that ever own'd a *GOD*, deny'd him to be *Omnipotent*: This is a Notion all *Men* brought into the *VVorld* with them, who therefore when they are in any affliction or danger, lift up their *Hands* to *Heaven*, and ſend up their *Prayers* to him for the thing they wiſh for, and thereby tacitly acknowledge his *Omnipotence*. Yet there are ſome *Philoſophers* who ſeem to deſtroy this *Notion*, who aſſert the *Eſſences* of Things to be *Eternal*, as if without the *Power* of *God* they had ſome *Nature* of their own, to which *God* at a certain time did vouchſafe *Exiſtence*, and made them to be *Actual Beings*. And therefore they ſay, that *Poſſible things* only, that is, ſuch as are ſo in their own Nature, can be produc'd by *God*, and that his *Power* doth not extend it ſelf any further.

II. *What a* Poſſible, Neceſſary *and* Contingent Being *is.*

But becauſe this *Doctrin* ſeems to derogate from *God's Omnipotence*, we will endeavour to ſhew the Falſity of it, by declaring what the true Nature of a *Poſſible*, *Neceſſary*, and *Contingent Being* is, and whence they take theſe Affections. A *Neceſſary Being* is ſaid to be ſuch with a twofold reſpect, either with reſpect to its *Eſſence*, or to the *Effective Principle* whence it proceeds. After the firſt manner, we know that *God* only doth neceſſarily *Exiſt*; and therefore he is ſaid *to Exiſt ſo, as that he cannot but exiſt*; becauſe *Exiſtence* is involved in his Conception, ſo that his *Eſſence* cannot be underſtood without it. But after the Second manner, that is, with reſpect to the *Effective Principle*, *Corporeal things* are ſaid to be Neceſſary, foraſmuch as they can be produced by *God*; but not with reſpect to their own *Eſſence*, becauſe we can clearly and diſtinctly underſtand the ſame without *Exiſtence*, and therefore they can never exiſt by virtue of their *Eſſence*. That is call'd a *Poſſible Being*, whoſe *Efficient Cauſe* is known to us; but yet we do not know, whether he be determined to produce it or no; and therefore is commonly deſcribed, *That which hath not been, but might have been*; and in this ſenſe all things beſides *God* are ſaid to be *Poſſible*. But if we conſider only their *Nature*, and not their *Productive Cauſe*, we ſhall call all things *Contingent*; becauſe with reſpect to their *Natures*, no neceſſity of *Exiſting* is found in them, as in *God*: Neither is there in them any *Repugnancy* or *Impoſſibility*, but that they may be; and therefore in caſe they do exiſt, *they exiſt ſo, as that they may not exiſt*.

III. *All things preſent, and things to come, depend on* God.

We will now ſhew, That all things that are now, or are to come, have their Dependence on *God*; and that there is nothing in Nature, that doth not proceed from his *Decree*. For ſeeing no *Creature* exiſts *by the neceſſity of its Eſſence*, it follows, that they muſt all borrow their *Being* from the *Divine Decree*. For it is evident by the *Light of Reaſon*, that it is impoſſible a thing ſhould *exiſt*, which hath no *Internal* or *External Cauſe* of its Exiſtence: Now no *Creatures* can exiſt by the Power of their own *Nature*, and therefore we muſt have recourſe to one only *External Cauſe*, *viz.* the *Divine Decree*, for their Exiſtence; in which *Divine Decree*, if their *Exiſtence* be not found, they are to be look'd upon as Impoſſible, foraſmuch as they cannot be produc'd by any *Cauſe*. From whence

whence it evidently follows, not only that the *Existence* of all *Creatures* doth depend of *God*, but also their *Nature* and *Essence*: for seeing there is no perfection which is not in *God*, there can be no *Essence* in the *Creatures*, which should be the cause of *Gods knowledge*. Wherefore we must conclude that all *Creatures* before *Gods* Decree were nothing, and consequently that of themselves they have no necessity to *exist*.

IV. *God is the Efficient Cause not only of substances, but also of their Modes.*

When I say that all things have their Being from the *Divine Good Pleasure*, this to be understood not only of *Material Substance*, but also of *Thinking* or *Spiritual*; because not only the *properties* and *Modes* of *Bodies* derive their reality from the *Will of God*; but also the *Modes* of *Minds*. For it is a meer prejudice of our Youth to imagine that the *Modes* of *Cogitation*, *Knowledge*, *Judgment*, *Affections*, and other inward *Acts* of our *Mind* do less depend on the Divine Power, than the *Modes* of *Material* and *Bodily things*. Because whatsoever is not God, is of it self altogether nothing; neither can it exist but by his *will*; for since nothing can be the cause of its own *Existence*, save *God* alone, it follows that whatsoever exists, must derive all its reality from *God as its first Principle*.

V. *In what sense the Natures of things may be said to be immutable.*

If it be objected that the *Essences* of things are commonly said to be Immutable and Eternal. I answer, that the *Essences* of things are only said to be immutable, forasmuch as they are expresst by *Definition*, and are consider'd Universally, as is commonly done in *Sciences*, whose certainty requires firm and stable Definitions. So the Definition of a *Mind* that it is a *Thinking substance*, is always the same, neither is lyable to any change, tho perhaps there may be a further degree of perfection in the *Mind* of one *Man*, than of another. And whereas they are said to be *Eternal*, or that their *Essence* was known from Eternity in the *Divine Intellect*, this does not argue any Eternity in them, but in God; since to be known in the *Mind* of *God*, with respect to the *Creatures*, is only an *Extrinsecal Denomination*, or an *Entity of Reason*, which superadds no reality to things.

VI. *No things are Contingent with respect to God.*

As for Possible and Contingent Things, there are none such with respect to *God*; Because there are none that of themselves can *Exist*, and not *Exist*, or that have real Contingency. For surely there is no less Power to the *creating* of a *thing*, than to the Conserving of it; and since no *created thing* acts any thing by its own *Power*, so neither can it give it self *Existence* by the same. It remains therefore that all things must have their Dependence on *God*, and that the things that are, be produced by vertue only of the *Divine Decree*. And forasmuch as there is no Change or Inconstancy in God, we must conclude that the things which he *creates*, have from *Eternity* been decreed to be *created* by him; so that all *Creatures* from Eternity had a kind of necessity of *Existence*; And therefore that no Things are *Possible*, *Necessary*, or *Contingent* of their own *Nature*, but by the *Divine Decree*, which is the only Cause of all things.

VII. *Nothing can be supposed antecedent to Gods Decree.*

Neither doth it contradict what we have said, that *God* might have decreed otherwise concerning his *Creatures*, and that upon that score they may be said to be *contingent*; For since in *Eternity* there is no Before or After, first or last, it is a Vanity to search after those Moments in which *God* existed before those *Decrees*, and in which it is supposed that he might have determin'd otherwise. Wherefore since *God* without any necessity resolved to make *Creatures*, they are all of them said to exist Contingently, because they include no Necessity of *Existing*; tho with respect to the *will* of *God* they *exist Necessarily*: Forasmuch as no greater necessity can be conceived in Things than that whereby an Effect follows from an Efficacious *Principle* and a Determinate *Efficient Cause*.

VIII. *How the Will of Man is said to depend on God.*

There is one difficulty more remains to be discust, and that is since all *Creatures* are predetermined by *God*, and that there is a kind of necessity of *Existence* in them from Eternity, how the Will of *Man* can be said to depend of *God*, seeing that it is *free*, and indetermin'd. But notwithstanding this, we must say that the Will also is conserved by the *Divine Concourse*, so that it is not in the *Power* of *Man* to *Will* or *Act* any thing, which is not preordained by *God*. But how these two things may be reconciled, that *God* hath *decreed* all the *Acts* of our Will from Eternity, and yet our Will remains undertermin'd, is I confess more than I do clearly perceive. I do acknowledg my *Mind* to be but of a *finite* capacity; and the *Power* of *God*, whereby he hath not only foreknown all present and future things from *Eternity*, but hath also decreed and determin'd them, to be *infinite* and unbounded: Yet cannot this consideration make us doubtful of the *Freedom* of our Will, since in all our *actions* we experience our selves to be free, and that it is in our Power to give or withhold our Assent; which is so manifest that we have good reason to rank it amongst first and common *Notions*.

IX. *It is a difficult thing to reconcile the Divine Decree with the Liberty of Mans Will.*

Hence is it that the Famous *Philosopher* in the Ninth *Epistle* of his I. *Volume*, saith. *As to Free will, if we only consider our selves, I must confess we cannot but think it to be Independent: But when we cast an Eye on the Infinite Power of God, we cannot but believe that all things must depend on him, and therefore that our free will is not exempt from his Command. For it implies a contradiction that God should have created Men of such a nature, that the Actions of their will should not depend on his will: Because that is the same as if one should say that his Power is both Finite and Infinite: Finite since there is something that doth not depend on it; and Infinite, in that he was able to create this thing Independent. But as the knowledg of the Divine Existence, must not take away the certainty of our free will: So neither must the knowledg of our free will, make us to doubt of the Divine Existence. For the Independency we experience and find in our selves, and which makes our actions blame or praise worthy, is not opposite to a dependence of another kind, whereby all things are subject to God.*

X. *God is no less a cause of the Creature when it is made than when it is a making.*

Gods Omnipotence does not only appear in the Production of *things*, but also in their conservation: for *God* is not only the *Principle* of *created Beings* when they are making, but also when they are made. Hence it is that he preserves them by a continual Influence; and should he cease from his Concourse, whatsoever he hath produc'd would fall to nothing; Because before they were *created* and he afforded them his Concourse, they were nothing. Neither doth it contradict this, that all things that are produced by *God are substances*, to whom

whom it does agree to subsist; for they are not call'd *Substances* as if they could subsist without the *Divine Concourse*, but because they are such things, as do not need the assistance of any *creature* towards their being. In which Preservation of the *creatures*, the infinite *Divine Power* is evidently exemplified, in that he hath produc'd all things so, as that they cannot subsist one moment without him, like as the Image of the *Sun* reflected in the *Water*, or in a *Looking-glass*, doth depend on the *Sun*, not only as to its being, but as to its Preservation or continuance.

CHAP. XV.

That God is the Creator of all things.

I. *Some Attributes agree to God from Eternity, others in Time.*

THO all the *Divine Attributes* be Eternal, and undistinguisht from his *Essence*, yet do not all of them in a like manner agree to him. For some of them constitute his *Nature*, and can only by the operation of our *Minds* be separated from it, such as are his *Eternity*, *Omniscience*, &c. Others again presuppose *creatures*, and are only attributable to him since the beginning of the *World*, as to be a *Judge*, a *Creator*, &c. Which from *Eternity* did only Potentially belong to him. But because the *Power* to *create* the *World* was in *God* from *Eternity*, and that it appertains to his Nature to be *Omnipotent*, it is as easy to prove *God* to be the *Creator* of all things, as it is to evince him to be *Immutable*.

II. *Whatsoever hath a Being, hath it either from it self, or from another.*

For whatsoever is besides God, either hath the Principle of its *Existence* from it self, or from another: For natural light evinceth that things can not be made of nothing. If any thing was of it self, it would want nothing; Yea, it would give it self all those Perfections it hath any *Idea* of; but nothing hath the Power of bestowing those perfections on it self, for otherwise it would actually be possest of them; for the *Will* is infallibly carried to the Good it knows; and consequently it hath not the *Power* of giving it self a *Being*. If it hath its *Being* from another, we may then demand whence that other hath his *Being*, whether from it self or from another, till we come to the last *Cause*, who is the *Author* of all things that *Exist*.

III. *Forasmuch as the Parts of Time have no necessary connexion, it follows that Creatures are not preserved by themselves.*

Besides, the Parts of *time* have no necessary defendence on each other; neither doth is follow that because a *thing* is now, it will be the next Moment: Therefore to the end it may continue to *exist*, there must be some *Power*, which may each Moment reproduce it: But no such *Power* is in the *Creature*, and therefore there must be some *Being*, whose *Nature* includes *Existence*, and which is the *Cause* why the thing that hath existed hitherto, doth continue so to do. For tho' a thing have begun to *Exist*, yet doth not its Essence any more involve necessary *Existence*, than it did before its *Existence*; and therefore it stands in need of the same Virtue to continue to *exist*, as it had to begin to *exist*.

IV. *The Essences of things are clearly known by abstracting them from Existence.*

Moreover we clearly understand, that the *Soul* of *Man* is *a Thinking Substance*; that a *Body* consists of three Dimensions, and that *Man* is a compound of *Mind* and *Body*, without any *Existence*: Wherefore we ought not to ascribe to *Man* any *Power* whereby he can *exist*, and therefore he must be *created* by *God*, before he can *exist*. For every Effect we know is contained in its Cause, either *formally* or *eminently*, and seeing neither the *Soul* nor the *Body*, nor *Man* that consists of both, can be the *Causes* of themselves, they cannot be contain'd in themselves as in their *Cause*; and therefore we must look out for a higher *Cause* that may eminently contain whatsoever is formally found in the *Creatures*; and that is that which we call *God*.

V. *Abstractions do more clearly explain the nature of a thing.*

And forasmuch as the *Form*, according to *ARISTOTLE* gives *Being to a thing*, and *Concretes* are more perspicuously understood by their *Abstracts*; for a Confirmation of what we have said, it will be worth our enquiry what *Creation* is, and whether the name of *Creator* could be attributable to *God* from Eternity.

VI. *What Creation is.*

As to the first, the received Definition of Creation is, that it is *the Production of a thing out of Nothing*; Which may be admitted without Hesitation, if by *Nothing* we understand a Negation of all Reality, and not any thing Imaginary, which some do suppose to be that out of which all things are produc'd. For some do conceive this *Nothing* to be, as it were, a *matter* shut up in an Imaginary space, from whence all things do proceed. Wherefore, lest I should seem to favour their Error, I will take away all Ambiguity and define it thus, *viz. That it is an operation, whereby things are produc'd by an efficient Cause, no other Cause concurring with it.* So that a thing is said to be *created*, which besides *God* needs no other Cause towards its *Existence*. Where it appears that neither *Modes* nor *Accidents* are *created*, since they depend on the *Substance*, in which they are, and without which they cannot be conceived: As we have shewed in our *Logick*, in the *Chapter* of *substance*.

VII. *What we are to understand by the Name Creature.*

A *thing Created* is that whose nature or *Essence* can clearly be understood without *Existence*. As *the Soul of Man*, of which we have a clear and distinct Notion, for as much as it is *a Thinking Substance*, abstracted from its *Existence*. And solikewise we have a distinct conception of a *Corporeal Substance*, as including *three Dimensions*, without considering its *Existence*: And therefore these must be *Created* by *God* before they can *exist*, and when they do so, must be preserved by his continual Influx.

VIII. *Before the Creation of the World there was no Time.*

It remains now to enquire whether *God*, could be call'd a *Creator* from Eternity, or whether the things created by him could have their *Original* before all Time. Before we can resolve this clearly, we are to take notice that before the Creation of the World, no *Time* can be understood by us, seeing that *Time* is nothing else but the measure of *Duration*; or to speak more clearly, is nothing else but a meer Mode of *Thinking*. For as the *Modes* of *Material things* serve for the easier explication of their *Natures*, so we make use of *Time* to express *Duration*, so that it is necessary that before *Time* could be, there must have been, not only *Creatures*, but *Men* also, that might compare the *Duration* of things *Existing*, with the *Duration* of other things, that had a determinate *Motion*. Now *Duration*, seeing it is not distinct from the *Existence* of things, save only by Reason, begins as soon as they began to *exist*, and ceaseth when they cease to be; because it supposeth them to be *Created*. Wherefore they who imagine *Duration* or *Time* before the first Production of *things*, are as deeply prejudic'd as those are who fancy an Exten-

ſion of *Space*, without any Bodily Extenſion. To enquire therefore, whether a *Created thing* could be from Eternity, is as much as to demand whether there can be a *Duration* without any *Beginning*, and which cannot be expreſſed by any Number whatſoever.

IX. *God cannot produce Eternal Duration.* That ſuch a *Duration* as this cannot be created by *God*, appears from hence, that no *Duration* can be mentioned, but that *God* is ſtill able to produce a greater. For ſuch is the *Nature* of *Duration*, that aſſign what *Duration* you pleaſe, a greater or leſſer can ſtill be conceived, ſeeing that it is, as it were compoſed of Parts, and always may be conceived as Diviſible into them: For as there are no parts in a *Body*, altogether Indiviſible; ſo neither are there any *Moments* in *Duration*, but may ſtill be divided into leſſer parts to Infinity.

X. *No Duration can be underſtood to be in God.* Neither can we ſay, that becauſe *God* hath been from *Eternity*, and is ſtill, therefore we ought to attribute to him the greateſt *Duration* that can poſſibly be conceived; for it is evident from what hath been already ſaid, that no *Duration* conſiſting of Parts can be aſcribed to *God*, but *Eternity* only, which is not an affection of *Exiſtence*, but of *Eſſence*: And therefore that we cannot conceive any *Duration* in *God*, except we have a mind to deſtroy the *Idea* we have of him; foraſmuch as it is eſſential to the notion of *Duration* that none can be conceived ſo great, but ſtill greater may, which in no wiſe can be attributed to *God*, who is Infinite, and admits no Diviſion of Parts.

XI. *Whether God could have Created the World from Eternity.* You will ſay that *God* is as Powerful, whilſt he acts freely, as if he did act neceſſarily, ſince liberty or neceſſity of acting, doth not alter the property of Power. But if *God* acts by neceſſity of *Nature*, he muſt have *Created* the *World* from *Eternity*, foraſmuch as his *Power* is *Infinite*, and conſequently it is no contradiction, that a *Creature* ſhould be *Eternal*, that is, be produced without a *Beginning* of *Duration*.

XII. *Anſwer.* I Anſwer, that this *Argument* is deduced from a falſe *Hypotheſis*, *viz.* that if *God* ſhould act neceſſarily, he might for all that be of *Infinite Power*, which is very falſe; becauſe it is the Property of a moſt *perfect Being* to act freely, which is ſo eſſential to it, that it can never be ſeparated from its *Idea*: ſince there is but one only *Being*, that by us is conceived to be ſuch.

XIII. *God can produce ſtill greater and greater Duration.* Beſides, it is the *Nature* of *Duration* that how great ſoever any is ſuppoſed, it may be ſtill ſuppoſed greater; and therefore *God* who is of *Infinite Power* and a free *Agent*, may always produce a greater or leſſer *Duration* than the ſuppoſed *Duration* is. But if *God* did act according to the neceſſity of *Nature*, no ſuch *Duration* would be poſſible, becauſe *God* acting neceſſarily, would only produce that which did follow from neceſſary Action; and conſequently being unable to produce a greater, his Power would be Bounded, which is deſtructive of the *Idea* of *God*.

CHAP. XVI.

Concerning Gods Government of the World, and Providence.

I. *Supposing God to be All-knowing and All-powerful, he must also be Provident.* FRom what hath been already ſaid of the *Divine Attributes*, we may eaſily conclude that *God* is *Provident*, and the *Ruler* and *Governour* of all the *World*, and all things that are in it. For ſeeing that he hath *Created* all *things*, and by his alone Power, brought them into a State of *actual Exiſtence*, it ſeems to be Repugnant to his Goodneſs and Omnipotence, that he ſhould neglect the care of them, and leave them to the Government and diſpoſal of others. For ſince he is *All-knowing*, *All-powerful*, and ſupremely *Good*, he cannot but keep his *Eye* upon his *Creatures*, and govern and diſpoſe of them for their good. For Will and Power, with reſpect to things without them, are not diſtinguiſht from the *Divine Underſtanding*; and ſince *God* hath decreed that at ſome certain time, *Creatures* ſhould exiſt, he alſo determined them to exiſt ſo, as that their *Eſſence* and *Exiſtence* might depend on his *Will* and *Power*, without being able to attain any Ends without his ſpecial Providence.

II. *What Providence is.* By *Providence*, Divines underſtand that *Eternal diſpoſal*, by which *God* doth Efficaciouſly direct all his *Creatures* to certain ends foreſeen by him, ſo as that in time they come to attain them. For *Providence* doth not only denote the operation of the *Intellect*, by which a thing is foreſeen before it be brought to paſs; but alſo that of the *Will*, or the Decree and Counſel, whereby, before the *work* is done, it is diſpoſed to the end appointed for it. And that ſuch a *Providence* as this appertains to *God*, may be proved by ſeveral Reaſons.

III. *God would not be the moſt perfect Being in caſe he didnot take care of his Creatures.* For Firſt, it belongs to the Nature of *God* to be moſt perfect; but how can he be ſaid to be ſo, without being preſent to his *Creatures*, and taking care for them? For it is without doubt a greater perfection to provide for the Univerſe, and to govern and diſpoſe all things for the beſt, than to leave them to themſelves, or to be diſpoſed of by others. For by ſo much the more perfect, any one is, by how much the more he excells others in *Command*, *Wiſdom*, *Goodneſs* and *Liberality*: But if the care of the *World* ſhould be ſuppoſed taken away from *God*, we ſhall make him an Idle and Unactive *Being*, as *EPICURUS* doth; and by this means ſhall be able to conceive a more *perfect Being*, who together with the higheſt Felicity has the Sovereign command over, and diſpoſeth of all things, and whoſe Tranquillity is not diſturbed or interrupted by the Multiplicity of the Affairs he manageth. Wherefore, ſince nothing can be admitted to be more perfect than *God*, we muſt conclude, that he takes the care of, and diſpoſeth all things. *For it is not becoming*, as *DAMASCENUS* ſaith, *that there ſhould be one Builder or Architect of this World, and another that takes Care of it, foraſmuch as this would Argue a diſability in them both; in the one of Making or Effecting, and in the other of taking Care for and Diſpoſing of it.*

IV. *Gods Providence is proved from his Eternity.* *Secondly*, Foraſmuch as *God* is *Eternal*, having no Bounds of his *Exiſtence*, it is neceſſary that his *Underſtanding* ſhould be *Eternal* alſo, becauſe it belongs to his *Eſſence* to be conceived by us as Supremely Intelligent: Now his *Underſtanding* is not diſtinguiſht from his *Will* or *Decree*, but only by *Reaſon*, or our meer *Conception*; therefore when we ſay that *God* underſtood, or knew all things from *Eternity*, we at the ſame time aſſert, that he alſo from *Eternity* provided for all things, and deſigned them to their appointed ends; ſeeing that his *Will* is Supremely *Efficacious*, and never fails of the ends he intends.

The

To the Worship= full Ieffrey Ieffreys
of the Priory in Brecknockſhire &
of the Citty of London. Eſqr.
This Plate is humbly Dedicated by Richard Blome

V. *The same is made out from his other Attributes.*

The same may be confirmed from the rest of his *Attributes*: For if *God* be Sovereignly *Intelligent*, he must also be *most Wise*; and will not he be accounted more Wise by governing the *World*, and administring all things, thereby not only *Speculatively*, but *Pratically* understanding them? If *God* be *most Powerful*, he must be able to do all things, so as that nothing may be in a condition to resist his *Will*, or escape his *Power*. But how can this be, except he govern the things he hath produced, and concur to their *Actions*? If he be *most Good*, sure it is necessary that all *Creatures* experience his *Goodness*: But how can that be, if he takes no Care of them, nor Provides for them? Therefore we must own the *Divine Providence*; forasmuch as without it, his chiefest *Attributes* are destroyed, and nothing is left whereby we may demonstrate his Sovereign *Power*, *Wisdom* and *Goodness*.

VI. *God's Providence, and Government of the World, may be proved from the things themselves.*

Another *Argument* may be taken from the *Creatures* themselves. For whosoever considers the frame of this *World*, and the order of its *Parts*; whosoever takes a view of the *Earth*, the variety of its *Seasons*, the different Shapes of *Living Creatures*, the manifold *Virtues* of *Plants*; whosoever scans the *Fabrick* of the *Microcosm*, MAN, the multiplicity of his *Members*, with their admirable Connexion and Harmony: Whosoever takes a Prospect of the *Heavenly Bodies*, their Lustre, Beauty, constant Motion and Proportion, will be forced by his *Conscience* to acknowledge, that these *Wonders* could not be the product of *Chance* and *Fortune*, but the Effect of the *Great GOD*. And therefore CICERO, in his Book *de Natura Deorum*, speaks thus: *Shall we call him a Man, who beholding the certain Motion of the Heavens, the wonderful Order of the Stars, and all so fitly link'd and suited together; shall suppose that all this is manag'd without any reason, and by Chance; when indeed we can never have any Conceptions of the greatness of that Wisdom and Counsel which disposeth all these things?* When we see any thing moved by *Springs* and *Engins*, as a *Sphear* or *Watch*, have we any the least doubt of their being the Effects of *Reason*? and when we see the *Heavens* moving with admirable Swiftness, and constantly to persist in their *Motions*, finishing their *Anniversary Revolutions*, for the Health and Conservation of all Things; shall we question whether these Things are order'd and directed by a most Excellent and Divine *Reason*?

VII. *How any thing can be said to be by* Chance, *if all things be rul'd by* Providence.

Tho' no body that owns a *God*, can doubt of his *Providence*; yet this Difficulty remains to some, How any thing can be said to be by *Chance* in the World, if *God* governs all Things, and directs them to their certain Ends? And besides, How comes it to pass, that *God* taking Care of all things, his *Thunder* often spares the *Wicked*, and strikes the *Innocent*? Or, if every Motion, and all other things that keep their certain Periods, be called *Divine*, must we not also suppose *Tertian* and *Quartan Agues* to be such, whose Motion and Returns are so certain and constant?

VIII. *With respect to God, nothing happens by* Chance.

There is no question, but that many things happen by *Chance* in the World, with regard to *Second Causes*; but nothing at all with respect to the *First Cause*, who disposeth and fore-ordains all things from *Eternity*. For *Chance* and *Fortune* are only in respect of him, who is ignorant of the Intention of the *Director*: And forasmuch as the *Divine Intention* is hid from *Man*, till the thing be done; therefore the same, with respect to *Man*, is said to happen by *Chance*, but not with respect to the *First Cause*. How many things seem to happen in a *Commonwealth*, which with reference to us are *fortuitous*; but not so with respect to the *Prince* who governs it, who order'd things so on purpose, and made use of such *Ministers* and *Means*, so as that things could not happen otherwise? And whereas it is further objected, That sometimes *Thunderbolts* pass by the *Wicked*, and light upon the *Innocent*.

IX. *How things come to be so turbulently carried in this World.*

We are to consider, that all these things happen by *God*'s particular Direction, for very good ends, which tho' they be unknown to us, yet are not we therefore to deny them: For it is too great a piece of Rashness, to have so great an esteem for our own Wit, as that whenever we cannot find out the *True Cause* of any thing, we should presently suppose the World to be without a *Ruler*, and that the Concerns of *Men* are committed to the management of *Blind Chance*.

X. *Why wicked Men prosper in this World.*

But you will say, If there be a *Cause* that presides over *Inferiour things*, why do we perceive such Confusion in the *World*? Why are the *Good* neglected and oppress'd by *Poverty*, *Slavery*, and *Diseases*; whilst in the mean time the *Wicked* flourish, and abound with *Honour* and *Riches*?

XI. *Answer.*

This is the Complaint of most *Men*, who being ignorant of the *True Good*, are taken with the outside of Things: For if we attend to the Nature of *Good*, we shall find that *Vertue* alone deserves that Name, which whosoever wants, is worthily esteem'd *Miserable*. Hence it is that *Wicked Men*, being devoid of *Vertue*, do not make use of those outward *good things* with that Moderation of *Mind* as they ought, but in the midst of their *Riches* suffer *Want*, and in the midst of their *Pleasures*, *Pain* and *Torment*; so that they are not True good things to them, but in appearance only. But if on the other hand, *Evil things* happen to those that are *Good*, forasmuch as they are conducive to the exercise of their *Vertue*, they are rather to be accounted *Good things*, because by them their *Minds* are estranged from *Worldly Lusts*, and raised to the love and desire of *Heavenly things*. This therefore is the greatest Instance of *Providence*, when we see *Good things* bestowed upon Ill Men, that they may grow the worse; and *Evil things* upon Good Men, that thereby they may grow better.

XII. *Why God Created Men and Angels, whom he foresaw would be corrupted by* Sin.

But you will say, That *God* created *Angels* and *Men*, whom he foresaw would fall and continue in Evil or Wickedness. St. AUSTIN Answers, That *GOD* would not have created any *Angel* or *Man*, whom he foreknew would fall into *Sin*, if he had not known, at the same time, to what good Ends he could make use of them, and so compose the Harmony of this *Universe*, as a pleasant Song of *Discords* mix'd with *Concords*: For as these make the Sweetness of *Musick*, so the Beauty of this *World* is made up of these Contraries. And therefore in the *Third Book* of *Free-Will* he plainly teaches, That GOD ought not to have abstained from Creating of the *Creature*, whom he foresaw that by his own Fault (not by any of his *Creator*) should lose that *Beauty* in which he was *created*: For as a lost and wandring *Horse* is better than a *Stone*, which cannot wander, because it wants *sense* and *motion*; so

so that *Creature* is more Excellent, which *sins* by its Free-will, than that *Creature* which doth not *sin*; because it hath no *Free-will*. And as I would commend *Wine* as good in its kind, tho' I blame the Man that is made *drunk* by it, and yet would prefer this *drunken* and *blamed Man* before the *praised Wine* that had made him *drunk*: So likewise a *Bodily Creature* is to be commended in its degree and kind, whereas they are *Blame-worthy*, who by the immoderate use thereof, are turned aside from the Perception of *Truth*.

The Third Part
OF THE
INSTITUTION
OF
PHILOSOPHY.
VIZ.
DÆMONOLOGY;
OR,
Of Intelligences and Created SPIRITS, GENIUS's and DÆMONS, Commonly called
ANGELS.

A Prefatory Discourse.

Of the Division of Created Things; the Definition of Pneumaticks, or the Doctrin of Spirits, and its Certainty.

I. *The aim of the Author in this Treatise.*

NOtwithstanding that to Treat of ANGELS does seem chiefly to belongs to *Divines*, and the consideration of their *Nature* and *Faculties* may be thought to exceed the Bounds of *Metaphysicks*; yet I think it may not be useless to try what *Natural Light* can do in this case, and how far by the Guidance thereof, we may discover their *Essence*, *Existence*, and *Operations*.

II. *Division, a great Help to the Knowledge of Things.*

They who endeavour to search into the *Nature* of *Things*, take care to divide them, as fitly as may be, into those Parts which may be helpful to the obtaining a more distinct Conception of them. For *Division* takes away the doubtfulness of *Terms*, and makes that which before was confusedly perceived under one Name or Word, to be more clearly understood by more Words, expressing the Parts of it.

III. *The Division of Substance into Thinking and Extended.*

It is notorious to all *Philosophers*, that *Created Things* are divided into *Spiritual* and *Corporeal*, or into *Thinking* and *Extended*. By the Name BODY, all *Material* or *Extended Substances* are understood, of what Nature soever they be, whether they be more Gross or Subtil; whose *Essence* consists of three *Dimensions*, or in *Extension* in Length, Breadth, and Depth. And we call that an *Incorporeal Substance*, or *Immaterial*, which is without *Extension*, and all those *Modes* and *Accidents* which accompany a *Bodily Substance*. Whence it appears, how very improperly the Name of SPIRIT is attributed to the *Air*, *Wind*, *Fire*, *Vapor*, *&c.* because tho' these Things be more Thin and Subtil than others, yet don't they for all that cease to be *material*, *impenetrable*, and *indefinitely divisible*.

We

To the Worship-
-full John Jeffreys
of Llywell in the County of Brecknock
and of the Citty of London Esq.
This Plate is humbly Dedicated by Rich: Blome

G. Freman Inv.

I. Kip Sculp.

To the most Honourable Rose Marchioness Dowager
of Antrim, relict of the most Honourable Randall m.
Donnald, Marquiss and Earle of Antrim, Viscount
Dunluce; and sole daughter and Heyress of
Sr. Henry Oneille of Edenduf = Carick in the
County of Antrim in the Kingdome of Ireland &c.
This Plate is humbly Dedicated by Richard Blome

IV. *Quantity cannot be attributed to Angels*

We may also perceive with how little Reason some do *attribute* Quantity to *Angels* and *Human Souls*, and conceive one part of them to be without another, as if they were *Material*. Whereas if a *Man* consider a *Corporeal* and *Intellectual Substance*, he will find them to be distinguisht by Properties and *Attributes*, and to have no *affinity* at all with each other. For what Similitude can there be supposed between a *thing extended*, and a *Being* devoid of all *Extension*? Or what agreement is there, between a *Substance* that *understands*, *wills*, and *imagins*, and that which is divisible into *parts*, and is diversified by *Figures*, and which is commensurate to a certain space and *Place*?

V. *Substance is wrongly divided by some into immaterial and Bodily.*

Others divide *created substance* into *Immaterial* and *Corporeal*; but this Division doth not seem to be exact, or made according to the Rules of a *right Division*: because *Immaterial* and *Incorporeal* being *Negative Terms*, can represent no positive *Idea* to our *Mind*, such as is desir'd by all, where it may be had. For *Negative Words* represent no Properties or *Attributes* to our perception, and rather tell us what the thing is not, than what it is. True it is, that this *Division* is set down by many *Philosophers* of great note: but forasmuch as a Privative or Contradictory opposition (which those words do import) cannot have place in a lawful Division, this is not to be admitted. Moreover this *Division* seems to be grounded on this Childish mistake, that the *Substance* of *Material things* is more real, than that of *Spiritual*; and that therefore the former, as more perfect, are expresst by *Positive* words, but the latter, as more Imperfect, by *Negative*.

VI. *Is better divided into Thinking and Extended.*

Wherefore *Created Substance* is more fitly divided into *Thinking* and *extended*, or into *Intellectual* and *Corporeal*; because then the Dividing parts, are apprehended by Positive conceptions, and expresst by Positive *Terms*. For without doubt, we shall have a more clear notion of an *Angel* by conceiving him *Intelligent*, *Willing and Powerful*, than by apprehending him *Immaterial*, *Incorporeal and Invisible*: Forasmuch as these *Negative Attributes*, as I said, rather declare what an *Angel* is not, than what he is. Besides, he that perceives the Positive Properties of a *thing*, does by consequence understand the Negative; but not on the contrary: For he that knows an *Angel* to be *Intelligent*, doth at the same time know him to be *Incorporeal* and *Invisible*; but tho' he understand him to be *Incorporeal* and *Invisible*, he does not therefore understand him to be *Intelligent*; for the *Air* is *Invisible*, and yet is neither *Intelligent* nor *Incorporeal*. Wherefore *created Beings* are very properly divided into *Intellectual* and *Corporeal* or *Material*, for no *substance* can be conceiv'd by us, which is not either *Thinking* or *Extended*, or in other words, which is not *Active* or *Passive*. Hence St. *AUSTIN* saith, *Amongst things, some thing is acted, and not Acting, as a Body; another is Acting, and not Acted, as is God; and a third Acting and Acted, as are all Spiritual Substances.*

VII. *The Distribution of Science Universally consider'd.*

As all *created substance* is divided into *Material and Intellectual*, so the knowledge of that *Substance* is distinguish't into *SOMATICA*, or the *Science* of *Bodies*, and *PNEUMATICA*, or the *Science* of *Spirits*: Which may again be subdivided into other *Species*, according to the various notions under which a *Body* or *Spirit* may be considered. For as a *Body* is conceived by us, either as *Natural*, or as *Artificial*, or as having *Quantity*, and being *Figur'd*, or as subject to *Sickness* and recoverable; so accordingly divers *Species* of *Sciences* are constituted. *Natural Philosophy* considers a *Body* as *Natural*, and explains its *Essence* and *Properties*. *Mechanical Science* Minds the outward frame and structure of the *Body*, and the figures it obtains by workmanship and Art. *Mathematicks* take to task the various *Modes* of a *Body*, as the *figures* which bound it; the *situation* of one part with reference to others; the *Motion* or change of *situation*; and *Rest* or continuance in one place: Lastly, *Physick* or *Medicine* considers the *Body* as subject to *Diseases* and *recovery*, and endeavours to maintain the health, or to restore it when lost.

VIII. *The Division of Pneumatica, or the Science of Spirits.*

In like manner as *Intellectual Substances* are divided into *God*, *Angels*, and *the Souls of Men*; so *Pneumatica* is divided according to the Diversity of the *objects* it contemplates into *Natural Theology*, *Geniography* or the *Science* of *Angels*, and *Psychology*, or the Doctrin of the *Soul*. *Natural Theology* considers the *Essence* of *God* and his *Attributes*; *Geniography* the nature of *Angels* and *Intelligences*; and *Psychology* examines the constitution of the *Mind* of *Man*, its Faculties and Passions. So that *Pneumatica* is nothing else but the *science of Spirits*, which admits of divers names, as it Considers *God*, the *Angels*, or the *Soul of Man*.

IX. *The certainty of the Science of Spirits.*

The certainty of this *science* is very clear from its Definition, because it treats of *Incorporeal things*, and such as are not *subject* to change: For if *Natural Philosophy* which treats of a *Natural Body*, and *Mathematicks* which handles the *Modes* that follow it, deserve the name of *Science*, because they are founded on *Axioms of Eternal Truth*, much more doth the *Doctrin* of *Spirits* deserve the name of True *Science*, forasmuch as it is not only grounded on General Propositions, but likewise borrows its certainty from the Object it considers, and deduceth clearer Conclusions thence, than *Natural Philosophy* doth from a *Body* or *extended Substance*. For tho' the vulgar sort of *Mankind* is apt to be mistaken, and doubtful about *Immaterial Substances*, whether they do really *exist*, and think that the name of *Thing* ought only to be *attributed* to *Bodies*; yet the Lovers of *Wisdom* do own *Thinking substances*, to be much truer, and much more real than any *Bodily* or *Material Beings*.

CHAP. I.

Of the Nature of Angels.

I. *What we are to understand by the Name of Spirit.*

THE *Division* of *created Substance* into *Thinking* and *Extended* being suppos'd, it will not be difficult to conceive what a *Spirit* is, and how it is to be distinguisht from other *things*. For the *Word Spirit* is here to be taken in its most proper sense, for such a *substance* as is endued with the Faculty of *perceiving* and *willing*. Because as the formal Reason of a *Body* consists in Extension, which is always attended with Divisibility and Impenetrability; so the *essence* of a Spirit consists in this that it is a *Thinking Substance*, the concomitants whereof are Indivisibility, Perception and Volition. And as a *Body* cannot be conceived without

V.

Extenſion, ſo neither can a *ſpiritual Subſtance* without *Cogitation*: And therefore it is neceſſary that *Cogitation* do conſtitute a *Spirit* in its *ſpiritual* Nature, as Extenſion conſtitutes a *Body* in its ſenſible and diviſible Nature. Foraſmuch as according to *ARISTOTLE*, that is ſuppos'd to belong to the *Eſſence* of any thing, *without which* it cannot be underſtood.

II. *Some think there is no Subſtance but what is Material.* And whereas ſome ſuppoſe they cannot conceive an *Angel* without *Extenſion*, and ſo confound the Notion of *ſubſtance* with that of *Extenſion*; this proceeds only from a falſe prejudice they have entertained, *viz.* that there is nothing *Intelligible*, but what is likewiſe Imaginable, which certainly is a very great miſtake; for *Angels* and all other *Spiritual Subſtances*, cannot be reached by our *Imagination*, but only by our *Intellect*. For all Men generally take an *Extended Being*, to be ſomewhat Imaginable, in which there are various parts of a determinate *Magnitude* and *Figure*, and whereof the one is not the other; which Notion in no wiſe can agree with *Spirits*.

III. *Spirit is a general name to Angels and Dæmons.* By the Name *Spirit*, therefore we are here to underſtand a *Finite Thinking Subſtance*, altogether independent on, and free from Matter: Under, which *Angels*, *Dæmons* and *Intelligences* are comprehended; neither is there any Diſtinction between them, ſave only that the *Angels* are Good, and the *Devils* Evil; that theſe aim at the *Deſtruction* of *Mankind*, the other aſſiſt their *Salvation*; theſe abide in *Sin*, the others continue in *Grace*; theſe are bound in *Hell*, the other enjoy the Viſion of *God* in *Heaven*: All other things, as *Eſſence*, *Exiſtence*, *Knowledge*, *Power*, *the taking up of Bodies*, *Talking together*, *&c.* being common to them both.

IV. *The Angels are Immaterial Subſtances.* From the Definition of a *Spirit* or *Immaterial Subſtance*, we may with great Evidence conclude, that *Angels* are *Pure Spirits*, or as *DIONYSIUS* in his fourth Book concerning *Divine Names*, ſaith, *Free from Matter*, *and Incorporeal*. Becauſe a *Thinking* and an *Extended Subſtance*, are altogether diſtinct from each other, ſo that the one of them can be clearly perceived without the other. For we moſt clearly perceive a *Spirit* or *Thinking Subſtance* without a *Body*; and on the contrary, a *Body* without a *Spirit*. Now things that are thus diſtinguiſht, cannot agree to one and the ſame *Subject*: Becauſe theſe *Attributes* are altogether different; and there can be no greater oppoſition between *Attributes* of *Subſtance*, than *Diverſity*. And therefore to ſay, that *Extenſion* and *Cogitation* agree to one and the ſame *Subject*, is in effect to affirm, that one and the ſame *Subject* can have two *Natures* or *Eſſences*, which cannot be ſaid of a Simple thing without a Contradiction. Becauſe *Cogitation* and *Extenſion* are not only two *Eſſential Attributes*, but alſo conſtitute the nature of the thing to which they are attributed, and are more inconſiſtent, than *Blackneſs* and *Whiteneſs*, *Heat* and *Cold*, in the ſame Subject. For *Heat* and *Cold* may ſucceed one another in the ſame *Subject*, and the ſame thing which is *Cold* now, may afterward become *Hot*: But it is altogether Contradictory that *Cogitation* and *Extenſion* ſhould be in the ſame ſimple Subject, and conſtitute two Natures at once, or Succeſſively.

V. *Foraſmuch as Angels* Moreover, if *Angels* were *Material*, they might be divided; for *Diviſibility* is a Concomitant of Extenſion; but *Angels* are not Diviſible, therefore they are not *Corporeal* or *Extended*. The *Minor* is thus proved: The *Eſſence* of an *Angel* conſiſts in *Cogitation*, which admits of no Diviſion; or no body can conceive the half of a *Thinking Being*; wherefore *Angels* are exempt from *matter*, and from any Corporeity, how ſubtil ſoever the ſame may be conceived. *are Indiviſible, they are likewiſe Incorporeal.*

VI. *The effects of Angels proves their Incorporeity.* The *Immateriality* of *Angels* may be made out from ſome *Effects* that exceed all *Human Power*, and the utmoſt activity of *Bodily* force: Such as are the *Antient Idol Oracles*; the *Speech* of *PEOPLE POSSEST*, which are often in thoſe *Languages*, which the poſſeſſed party does not underſtand; *the Penetration of Bodies*, and ſuch like, which are an inconteſtable proof of *Intelligent Natures*, and which exert their Activity without the help of any Body. Beſides we Read in *Scripture* that a vaſt multitude of *Devils* entred one *Body*, *Mark* 5. yea, a whole *Legion*, which according to the moſt common Account contains 6666, which is abſolutely impoſſible, if the *Devils* have *Bodies* and take up a determinate place.

VII. *Whether Angels be capable of Generation.* They who aſſert *Angels* to be *Compound Beings*, and to have *Bodies*, tho' much purer, and of a more ſubtil *matter* than ours, endeavour to confirm their Opinion from *Gen.* 6. where it is ſaid, that the *Sons of God came in unto the Daughters of Men, and they bare Children to them, and the ſame were Mighty Men or Giants.* Which could not be, except we ſuppoſe the *Angels* to have Bodies; *Spirits*, as purely ſuch, being incapable of Generation.

VIII. *What we are to underſtand by the Sons of God in Scripture.* But this place is wrongly interpreted; for by the *Sons* of *God* in that place we are not to underſtand *Angels*, but the Poſterity of *Seth*, who imitating the Pious conduct of *Enos*, did worſhip *God*, and call upon his Name; but their Poſterity degenerating from the Piety of their *Fore-fathers*, and plunging themſelves into *Carnal Concupiſcence*, joyned themſelves with the *Daughters* of *Men*, that is, with *Cain's* Poſterity; from which Conjunction *Giants* were born, that is, monſtrous and deformed *Bodies*, as a Puniſhment of their Luſt. For it is contrary to Reaſon to ſuppoſe, that *Angels* can Generate. Wherefore, the *Fathers* of theſe *Giants* were not *Angels*, but *Men*, as the *Scripture* ſufficiently declares, *Gen.* 6. 3. *My Spirit ſhall not always ſtrive with Man, for that he is Fleſh.*

IX. *Objection that the Angels will be equal to God in the Simplicity of their Natures.* But will ſome ſay, if the *Angels* be altogether exempt from Compoſition, and any Matter whatſoever, they will be as Simple as *God* himſelf as being the one as well as the other *Pure Spirits*, having only an *Eſſence*, and ſome *Modes*, which do not hinder Simplicity.

X. *The Simplicity that is in God is very different from the Simplicity which is in Angels* To which I Anſwer, that tho' neither in *God*, nor the *Angels* there be any *Compoſition* of *Matter* and a *Subſtantial Form*, yet are not the *Angels* exempt from all other *Compoſition*, as conſiſting of Potentiality and Act, of *Eſſence* and *Exiſtence*: Which *Compoſition* is not to be found in *God*, foraſmuch as the *Divine Modes* are only diſtinguiſht by Reaſon (that is, our way of Underſtanding) from the *Eſſence* of *God*. Wherefore the *Schoolmen* call *Angels* and *Souls Impure*, and *Imperfect Acts*, but *God* the moſt *Pure* and *perfect Act*. Hence it is that *DES CARTES* in the 23 *Article* of the *firſt Book of his Principles*, Teacheth, that *our Mind* (*and the ſame is to be underſtood of Angels*) doth

doth understand, and will, by Operations that are in a manner distinct; whereas, God *by one and the same most Simple Operation, doth Understand, Will and Act,*

XI. Angels *do not understand all things actually.*

Besides, *Angels* have not actually all the *Cogitations* they can have, seeing that many things can be Revealed to them by *God*, and we understand them to have many *Thoughts* potentially only; so that at the same moment of time, they are conceived as Thinking in part Actually, and in part Potentially. Which is sufficient to denominate them Compounded, and excludes them from the Simplicity which is in *God*.

CHAP. II.

Whether the Existence of Angels be demonstrable by the Light of Nature, and how the same may be Evinced.

I. *The Antient Philosophers believed* Angels.

IT was the constant Opinion of the *Antient Philosophers*, that there were *Dæmons* and *Genii* or *Intellectual Substances*, which did preside over the things of this *World*, and were the managers of *Heavenly things* also, as so many *Divine Ministers*. For they thought it not beseeming the *Majesty* of *God*, to Administer the *World* by himself, but that he made use of *Ministers* and *Servants*, in the discharging of so many different *Offices*. For should *God* be thought inferiour to the *King* of *Persia*, who residing at *Susa* or *Hispahan*, Govern'd his large extended *Empire*, and by the Hands and Heads of others, was every where present with his *Subjects*, provided for them, and defended them? Seeing therefore that *God* hath his *Ministers*, they must needs be *Spirits*, that is, most active and ready to expedite his Commands: But how can they be such, if they be clog'd with the weight and cumber of a *Body*? Whence they conclude, that there are *Angels*, which are call'd *Genii*, forasmuch as they assist *Men*; and *Dæmons* as they are the *Administrators* of this lower *World*; this is confirmed by a Verse quoted by *CLEMENS ALEXANDRINUS*, and ascribed to *ORPHEUS*.

Standing about thy Throne the Angels are,
Who of Mankind do take the Active Care.

II. God *can govern the World by himself.*

By this way of Arguing it appears, that the *Antient Philosophers* did believe *Angels*, tho' it does not prove that they really Exist; forasmuch as all those things, which they commit to the care and management of *Genii* and *Dæmons*, may be done by *God* alone. Neither indeed is it unbecoming the *Divine Majesty*, by his own Power to provide for his *Creatures*, without the assistance of any *Ministers*, to share in the Burthen of the *Government*: For *God* being *Omniscient* and *Omnipotent*, always chuseth that which is best, and therefore does not stand in need of any *Angelical Assistance*, in the Execution of his designs. And if there be any *Intelligences* in the *World*, that perform his Commands, that is because *God* thinks it best, and most conducing to that State of the *World*, which in his Wisdom he hath allotted it, that so the *Universe* should be a kind of *Commonwealth*, wherein He as *Lord paramount*, should Govern and Administer all things, especially the concerns of his Rational *Creatures* by the Mediation of *Angels*, as subordinate *Magestrates* under him.

III. *The Existence of*

Neither indeed is it so easie a matter, to prove the *Existence* of *Angels* by the *Light* of *Nature* only; because tho' we have a clear and distinct perception of *Spiritual things*, as they are *Thinking Beings*, and distinguished from things extended; yet forasmuch as their Existence is only Possible and Contingent, all that we can infer from thence is only thus much, That *Angels* may Exist, but not that they do really so. For if the *Existence* of *Angels* could be demonstrated, it must be by an Argument *à Priori*, when we demonstrate any thing by its neerest *Efficient Cause*; but so we cannot prove, that *God* the Maker of all things hath Actually *Created Angels*, since *Creation* depends one the meer Good Pleasure of *God*, which cannot be known to any without a *Special Revelation*. *Angels cannot be demonstrated à Priori.*

IV. *The Existence of Angels proved from their effects.*

Wherefore we can have no certainty of the *Existence* of *Angels*, save only from their *Effects*, or other *signs* that argue their presence. Thus we may prove, that there are *Angels*, from *Persons* Possessed, who tho' they be altogether Ignorant and Illiterate, do notwithstanding Speak strange *Languages*, and Discourse of several things beyond their Capacity; declare what is done by *Persons* far absent, and are carried through the *Air*, notwithstanding the weight of their *Bodies*. Who can deny, but that all these things must be performed by *Spirits*, since they Transcend the Activity of *Bodies*, and the Power of Nature?

V. *Soothsayers and Oracles prove the Existence of Dæmons.*

The *Existence* of *Angels* is confirm'd by the Answers of *Idols*, and the Predictions of *Soothsayers*, and those unwonted Motions, the Cause whereof cannot be assigned, unless we should say, that they are produced by such Invisible Agents. For we must not say, as some do, that these *Effects* may be produced by the *First Cause*; because *God* never Thwarts himself, nor does any thing Derogatory to his *Glory*, as are the *Idol Oracles*, and things done by *Persons* that are Possessed.

VI. *From the inactivity of Matter, we may infer, there must be Spirits to move it.*

It is a received *Axiom* amongst the *Antient Philosophers*, That a *Body cannot move it self*, or that *whatsoever is moved, is moved by another*: Wherefore there must be allowed some Active *Principle*, that may move Matter. For evident Motions must have a *Cause*, which cannot be *Coporeal*; for so the Question would return, By what *Principle* that was moved, and so to Infinity, till we come to some *Immaterial Cause*. Hence it is, that *ARISTOTLE* and other *Philosophers* hold, That *Intelligences* move the *Heavenly Bodies*: And consequently, that the *Superior Bodies* communicate no other Motion to Inferiors, but what they have first received from the *Angels*.

VII. *Reason convinceth us of the Existence of Spiritual Substances.*

Neither do we want very probable Conjectures of the *Existence* of *Angels*, if we consider the Harmony and Order of the *World*, and how its extream Parts are linked together, by Intervening Middle Parts. For since we see some things in the *World*, that are Compounded of a *Thinking* and *Extended Substance*, as Man, who consists of *Soul* and *Body*; it seems very Rational, that as there are things that are altogether *Bodily*, or that include nothing but *Extension*; so on the other hand there should be *Spiritual Substances*, whose *Idea* involves nothing but *Cogitation*.

VIII. *Apparitions of Angels.*

This may be confirmed from divers Apparitions of *Angels* mentioned in *Holy Scripture*, which happened in divers *Places* and *Times*: Thus, they appeared to *Jacob* as he was on his *Journy*, *Gen.* 32. To *Zachary* in the *Temple*, *Luke* 1. To *Guideon* in his *Fathers Ground*, *Judg.* 6. To our *Saviour* in the *Garden*,

Garden, Luke 22. To the *Childeren* in the *Fiery Furnace, Dan.* 3. In the *Prison* to *Peter, Acts* 12. At our *Lords Sepulcher, Mat.* 28. In the *Wilderness* to *Hagar, Gen.* 21.

CHAP. III.

Of the Faculties of Angels, and first of their Understanding, and its Object.

I. *A thinking Nature hath two Faculties.* *Intellectual Nature* hath two *Faculties*, *Understanding* and *Will*, which are as it were its Properties, and inseparable from it. The first of these perceives Objects by contemplating the *Notions*, it finds in it self; the other determines an *Intelligent Being*, to the embracing or avoided of a thing, or to suspend its *Judgment*, where the thing is not sufficiently understood. And forasmuch as these *Faculties* are distinguisht at least by *Reason*, and are variously conversant about their *Objects*, we will also separately handle them, speaking first of the *Understanding*, and afterwards of the *Will*. Because it will conduce much to the discovery of the nature of *Angels* to know how far their *Knowledg* and *VVills* do extend.

II. *The Various objects of Angelical knowledg.* As to the Object of *Angelical Understanding*, the *Schoolmen* dispute, First, whether *Angels* and *Devils* do understand the *mysteries* of *grace* by their *natural ability*. Secondly, whether they know the *Thoughts* of *men*, and can penetrate the *secrets* of their *Hearts*. Thirdly, whether they know *Future things*. The First Question I leave for *Divines* to determine, contenting my self to speak a few words to the two latter, which do not exceed the Bounds of *Philosophy*,

III. *The Common opinion of Schoolmen concerning the knowledg of Angels.* As to the second Question, viz. *whether Angels know Mens thoughts?* the common Opinion is that *Angels* and *Devils* cannot naturally know the Thoughts of Men without their consent. The Cause of this hiddenness of Mens Thoughts, some ascribe to the *Free VVill* of Man; others to the Abyss of *Mans Heart*; others to the *VVill* of *God*, who denies his Concourse to the knowing of them; others to the nature of Mens *thoughts*, which cannot objectively occur to others without the *VVill* of him that thinks them.

IV. *The common opinion refused.* But indeed all these *Reasons* are very weak, and do not at all prove that the Thoughts of Men are inscrutable by *Angels*; because the Perceptions and Determinations of *Mans Mind*, are in themselves no less *Natural*, than the very nature of *Angels*: And therefore as an *Angel* beholds his own *thoughts*, there seems no Reason, why they should not as well perceive those of other *Angels* and *Men*, seeing they agree in *Substance*. Besides, it cannot be doubted but the *Angels* understand their own *thoughts*, and those of others too, with their consent: But the Identity or Sameness of subject, or anothers consent, doth not encrease the Faculty, or communicate any perfection to it, or render the *understanding* Faculty more proportionate to its *Object*; wherefore if Angels by the consent of another can penetrate his *thoughts*, they may as well without it. Neither is it any objection against this, that humane *Actions* are free, and depend on their Wills, because all the foremention'd difficulties recur also upon this: And this only seems deducible from it, that *Angels* know such *Acts* as these to be free, and like to those they themselves produce. But who will say that *Elicit Acts* have such a dependence on the *will* that they cannot be known by another, without the consent of him that Elicits them, seeing there is no difference between *Acts* that are free, and such as are not free; and that the same *Act* may successively change its nature, and of Free become *Necessary*? Wherefore I think we may conclude, that as *Angels* can know Acts that are not free, so likewise may they those that are free.

V. *That Angels do penetrate the secrets of Mans Heart.* Wherefore let this stand fast, that *Angels* can perceive the *Thoughts* of *Men*: For seeing that *Angels* are *Intellectual Substances*, and that the *Perception* of the *Understanding* and *Determination* of the *will*, are the operations of *Intellectual Faculties*, there must needs be a Proportion between them. Besides, there are but few determinations of our *will*, which are not discovered by some *signs*, as by the motion of *Spirits* about the *Heart*, or by some outward tokens, which may give an occasion to *Angels* and *Devils* to discover the *Thoughts* and *Affections* of the *Heart*. But if all those *signs* were taken away, yet there is such an Agreement or Correspondence betwixt the Operations of the *Mind*, that they cannot but naturally perceive the Conceptions of our *Understandings*, and Decrees of our Wills. I my self some few years since heard a *Devil* speaking out of a possessed *Woman* at *Brussels*, who revealed the inward thoughts of many that came to her, tho' they were not discoverable by any sign. And when one of the standers by asked the *Spirit*, What it was he thought of at that instant? He told him that he resolv'd to take a Journey the next day, which he could not deny, but it was so. Neither needs this seem strange to us, seeing that we our selves would know as much if we were not shut up in these *Bodies*; and therefore are our *thoughts* hidden from others, because the Eyes of Men cannot pierce into our *Breasts*, which by reason of their materiality, are impenetrable. And it is probable that when some of the *Holy Fathers* deny'd the knowledge of *Mens thoughts* to *Angels*, it was for no other reason, but because they held them to be material.

VI. *An objection from Scripture.* If you say that this Opinion seems contrary to Scripture, I. Kings 8. 29. *ver. For thou only knowest the Hearts of all the Children of Men.* And *Jerem* 17. *ver.* 9. *The Heart is deceitful above all things, and desperately wicked, who can know it? I the Lord search the Heart and try the Reins.* In which places by the Heart are meant the secret *thoughts*, and whatsoever immediately depends on the *Mind*.

VII. *Answer.* This *Objection* is easily answer'd by saying, that the *Scripture* in these places doth distinguish *God* from *Men*, with respect to the *knowledg* of *thoughts*, but not from *Angels* and *Devils*. And whereas *Holy VVrit* seems to *attribute* this *Priviledg* to *God* only, not to *Angels*; this is, because it considers the *Angels* as *Gods Ministers*, and therefore ascribes to *God* whatsoever is done, or perceiv'd by them.

VIII. *By the knowledge of Future things, we are not to understand that which is gathered by conjectures.* As to the Third Question, *whether Angels know things to come?* We are to suppose that this is not to be understood of a knowledg of *Futurities* that may be gather'd by conjecture from probable *Causes*; as a *Master* of a *Ship* foresees a *Tempest*, or a *Physician* the probable Event or Issue of a *Disease*; or a *General* the Event of a *Battle*; but of the

Knowledg

Knowledg of *things* that are meerly Fortuitous and Contingent, which have no cauſes, or which are the effects of *Mans free will*; as that *John* will be kill'd by a Tile falling from a *Houſe*; or that *Peter* is to take a Journey to morrow.

IX. *Angels naturally cannot foreknow Future things.* I ſay therefore that neither *Angels* nor *Devils* do foreknow future Contingencies, which either have no certain *Cauſes*, or depend on Free will. The *Reaſon* is becauſe an *Effect* muſt be known either in it ſelf, or in its cauſe; but theſe Futurities cannot be known either way, and therefore cannot be known by *Angels*. That they cannot be known in *themſelves* is evident, becauſe they are not determin'd, neither have any neceſſity of exiſting; nor in their *Cauſe*, for that is free, either to produce or not to produce an effect. This may be further confirm'd thus; *Angels* are ignorant what themſelves ſhall act, before they have reſolv'd it with themſelves, and therefore much leſs do they know what others will do. And therefore ſome *Schoolmen* are of Opinion, that the *Devils* did not foreknow their *Fall*, nor the Miſeries conſequent upon their Sin.

X. *Yet they may probably Conjecture of things.* Yet it cannot be deny'd but that *Angels* and *Devils* may know many things by conjecture; ſince they can have a great inſight into the *Temper* and Propenſity of *men*, by knowing their Manners, and diſcerning the reſolutions and *thoughts* of their *mind* by *external* ſigns and tokens.

CHAP. IV.

Of the Will of Angels.

I *What the* Will *is, and whether it be found in Angels.* THE *Will* is here taken for that *Power* or Faculty whereby an *Intellectual Nature* produceth all its actions and thoughts that are of choice and determination, from himſelf without any force or compulſion. For it is the nature of a *Thinking* Being, that conſider'd in it ſelf, it can do ſomething, and determine it ſelf to *Act* or not to *Act*. Now this determination proceeds either from the *things* themſelves, without the Intellectual nature, or from the *Intellectual nature* it ſelf. The *Actions* which have no other *Principle*, beſides the Thing that Thinks, are called *Volitions*; and the *Intellectual nature* as it is to be conſider'd to be an *Elective Faculty*, and a ſufficient *Principle* to produce ſuch *Actions*, is called *Will*. Now, that ſuch a *will* is to be found in *Angels* cannot be queſtion'd, forasmuch as they are *Thinking Subſtances*, or *Beings* that of their own nature have a Power of *Willing* and *Nilling*.

II. *Two Doubts about the* Will *of Angels.* Concerning the *will* of *Angels* it may be enquired, Firſt, *whether this Active Power in them be free, and without force, from any thing that is External*: Secondly, *whether the Angels have ſuch a power over their Thoughts, that they can ceaſe from all Perception and Judgment.*

III. *The Will of Angels is free.* As to the Firſt it ſeems certain, that the *Will* of *Angels* is *free*, and cannot be forc'd by any Agent to do any thing, or leave it undone; becauſe the Nature of the *Will* conſiſts in its being free, ſo that it implies a contradiction for it to be forced by any External Agent, ſince no Agent can deſtroy the Nature of another, which would then be, if the *Will* ſhould *will* any thing with reluctancy. Beſides, the original of this Freedom comes from hence, that it is the very *Angel* himſelf, that determines himſelf, and wills this thing or the other; ſo that it depends on his own meer Will, that he *freely* Wills or Nills. Moreover, *The Will*, and *Free Will*, if well look'd into, are one and the ſame thing, and differ only in this, that the *Will* is underſtood to be the Chuſing or Elective Power, by which a *Cogitative Being* doth determine it ſelf, and perform all his *Motions* and *Actions* that proceed from the ſaid *Will*: And by *Free Will*, we underſtand the ſame Faculty, foraſmuch as it hath the Power of *Chuſing*. Now ſince both theſe are found in the *Angels*, they muſt by conſequence alſo have *Free Will*.

IV. *An Objection againſt the Liberty of Angels.* If you Object, That the *Angels* do infallibly follow and embrace the *Good* they know; and that therefore *Divines* ſay, That they *Love GOD* ſo, as not to be able to turn their *Love* from him: Becauſe by *Grace* they are ſo united to *God*, that they cannot be ſeparated from him, and are ſo ſatiated with the *Divine Glory*, that they cannot be drawn from the Enjoyment of ſo great a *Good*.

V. *The Objection Anſwer'd.* I Anſwer, That notwithſtanding all this, the *Angels* ſtill continue Free, and Love *God* freely; beeauſe the *Eſſence* of *Liberty* doth not conſiſt in *Indifferency*, but in the free determination of the *Will*, by which an *Angel*, or the *Mind* of *Man*, is ſo carried towards that which is propounded to it by the *Underſtanding*, either in Affirming or Denying, Embracing or Avoiding, as not to be determin'd thereto by any outward force. For the Indifferency of the *Will* only then takes place, when there are no Reaſons to ſway the *Mind* one way more than the other; which State is the loweſt Degree of *Liberty*, and argues no Perfection in it, but only a Defect in its *Knowledge*. For who can deny, That *Man* doth nothing more voluntarily, than thoſe things in which he finds not the leaſt cauſe of Doubting? Wherefore *Des Cartes* concludes in his *4th Meditation*, That *Divine Grace*, or *Natural Inclination*, do never diminiſh Man's *Liberty*, but rather increaſe and ſtrengthen it; and that a Man ought to be accounted ſo much the more *Free*, by how much the more he is byaſſed one way; either becauſe of his clear diſcerning of the *Goodneſs* and *Truth* that is in it, or becauſe *God* ſo diſpoſeth his *Thoughts*. Wherefore, when the *Angels* do inſeparably adhere to *God*, and are link'd to him by *ſtable Eternity*, as *Divines* expreſs it, they do not by this means loſe their *Liberty*, but by *Grace* are inclined to one part; and tho' indeed their *Indifferency* be diminiſhed, yet their *Liberty* is rather increaſed, ſince *to act Freely, and to act Voluntarily, are one and the ſame thing.*

VI. Liberty *may be conſider'd two ways.* The Matter will be more evident, if we conſider the *Liberty* of *Voluntary Actions*, either before, or in the ſame moment they are exerted: If the *Actions* of the *Will* be conſidered before they be exerted, there is no queſtion, but that the *Angels* have power to determine themſelves to one or the other Contrary, that is, to proſecute or avoid one and the ſame thing. Yea, according to ſome *Divines*, the *Angels*, whether *Good* or *Evil*, daily change their *Wills*. The latter, when they ſurceaſe their *Temptations*, finding that they are of advantage, rather than any hurt or hindrance to *good Men*. The former, when they forſake the *Wicked*, whom they find they cannot reclaim from their *Impiety*. But if we conſider *Liberty* in *Voluntary Actions* the ſame Moment they are exerted,

ſo it contains no *Indifferency*, in what ſenſe ſoever it be taken; whether for that State wherein the *Will* is not prompted to embrace one thing rather than the other, by any knowledge of the *Truth*, or *Goodneſs* of them; or whether it be taken for that Poſitive Faculty of *Intellectual Nature*, whereby it can chuſe, which it pleaſeth of two Contraries. Becauſe that which is a doing, cannot but be a doing at the ſame time it is a doing. And the *Liberty* which *Angels* have is ſuch, as according to the increaſe of their Faculty of *Acting*, as was ſaid before, is increaſed and ſtrengthned.

VII. *The Angelical Will is not determin'd to one Action.*

As to the Second Doubt, *VVhether the VVill of Angels be determin'd to elicit any Action; or whether it can at its pleaſure omit the ſame, and be void of all Thoughts?* I Anſwer, That the *VVill* of *Angels* is not ty'd to any certain *Action*, as being Indifferent of its own Nature, and not bound to any certain Knowledge, ſince they neither *love* themſelves, nor *God* neceſſarily, as their Natural End. Yet they cannot at their pleaſure rid themſelves of all manner of *Thoughts*, as ſome think they may, becauſe it is the Nature of a *Spiritual Subſtance* to *Think* always; and therefore it implies a Contradiction, for an *Intellectual Creature* to be without all *Thoughts*, ſeeing we underſtand nothing elſe by the Name of *Spirit*, but a *Thinking Being*.

VIII. *An Angel Thinks, whilſt he commands himſelf to ceaſe from Thinking.*

If any one urge, That an *Angel* may abſtain from all *Thoughts*, by commanding his Underſtanding to leave *Thinking*. I Anſwer, That this very Command or Will not to *Think*, cannot be exerted by an *Angel* without his being conſcious to it, and conſequently without his *Thinking*. For to *Nill* is as much a Thought as to *VVill*; wherefore *Angels* cannot ceaſe from all *Thoughts*.

CHAP. V.

Concerning the Power of Angels, as to the moving and producing of Bodies.

I. *There is a Faculty in Angels, to move Bodies.*

BEſides the Operations of the *Will*, mention'd in the foregoing *Chapter*, there is another whereby a *Spirit* doth move a *Body*, and acts upon another *Spirit* like it ſelf. For this Faculty is ſo intimate to a *Spirit*, that it cannot be conceived without it. We may indeed underſtand a *Spiritual Subſtance*, without the Power of Moving a *Body*, or of acting on another *Spirit*, in the ſame manner as we may underſtand a *Spirit* without the Faculty of *Perceiving* or *Willing*, which are two *Modes* of *Thinking*: But we cannot underſtand a Faculty of Moving it ſelf, or from its own ſtrength, without a *Thinking Subſtance*. And therefore we rightly conclude, That the Faculty of *Moving a Body*, and *Acting upon a Spirit*, do belong to *Intellectual Nature*, and is one Mode of *Thinking*.

II. *The Point confirmed by Examples fetch'd from Scripture.*

That this *Power* is in *Angels*, ſeems unqueſtionable; foraſmuch as *Holy Scripture* doth witneſs, that ſeveral *Bodies* have been tranſlated from one place to another by the Help of *Devils* or *Angels*. Thus we find the *Prophet* was Tranſported from one place to another by an *Angel*; the *Body* of *Chriſt* by the *Devil*, to the *Pinnacle* of the *Temple*; the *Stone* remov'd from our *Saviour*'s *Sepulcher*; and other like Examples, which prove *Angels* to have the Power of *Moving Bodies*.

III. *How Angels move Bodies.*

There remains only one Difficulty to be explained; How *Angels*, that are *Immaterial*, can move *Bodies*, ſeeing they impreſs no *Quality* upon them, neither do communicate ought to the Thing moved, as *Bodies* do.

IV. *Anſwer.*

I Anſwer, That *Angels* move *Bodies* by their *Wills*, neither is there any thing elſe required to it. For tho' *God* (as ſhall be explained in our *General Phyſiology*) be the *Univerſal Principle* of all *Motion* whatſoever; yet this doth not exclude *Particular Cauſes*, that have a Power of *Moving Bodies*, according to that degree which *God* hath been pleaſed to impart with their *Wills*. And tho' it be difficult to comprehend how a *Spirit* doth act on a *Body*, and move it; yet are we not therefore to make a Doubt of it, only becauſe we are ignorant how it is done.

V. *We meet with the ſame Difficulty in our ſelves about Motion, which we find in Angels.*

Indeed, if we duly weigh the Thing, we experience the ſame thing in our Selves: We find that our *Soul* moves our *Animal Spirits*, and directs them into the *Nerves* and *Muſcles*, meerly by the Inclination of the Will it hath to excite this or the other Motion in the *Body*: And we experience alſo, That the Motion of our *Spirits*, *Muſcles*, and *Nerves*, is conſequent upon this Propenſion of the *Will*; and yet all this while our *Soul* doth not underſtand, how and after what manner our *Soul*, being an *Immaterial thing*, moves a *Body*; and therefore neither is it any wonder, if we do not know the manner how *Angels* moves *Bodies*: In like manner neither do we underſtand, how from a certain Motion of the *Spirits* and *Blood*, the Affections of *Hunger* and *Thirſt* are ſtirred up in us, tho' we plainly feel them of our ſelves. Wherefore we are certain that *Angels*, being *Spirits*, move Bodies by their *VVill*, tho' the manner how, be hid from us, as being one of thoſe things our Underſtandings cannot reach.

VI. *Angels may Generate Bodies.*

Neither do *Angels* ſeem to be deſtitute of the Power to produce and generate ſome *Bodies*. For ſince *Generation* is performed by *Motion*, and that nothing elſe is required to *Generation*, but a fit and ſuitable adaption of *Parts*, according to the Conſtitution of every thing; there is no ſufficient Reaſon, why we ſhould deny *Angels* ſuch a Production. For in the *Generation* of a *Plant* or *Animal*, no new *Subſtance* is procreated, but only the *Particles*, whether Senſible or Inſenſible, acquire a new Connexion, and are otherwiſe diſpoſed with relation to their *Magnitude*, *Motion*, *Reſt*, *Figure*, and *Scituation*; after the ſame manner as a *Houſe* or *VVatch*, which are framed without the production of any New Subſtance, by the fit joyning of *Parts* before exiſting. And ſeeing *Angels* have the Power of moving, agitating, and reducing *Bodies* into order, neither can we deny them the Power of *Generating* them. Beſides, *Angels* having great knowledge of *Natural Things*, by the ſtudy of their Virtues and Diſpoſitions ſo many Thouſand years, they cannot be ignorant at what *times*, in what *places*, with what Meaſure the *Qualities* of things are to be temper'd, and what will be the product of the Mixture of ſuch and ſuch *Particles*. Beſides, we ſee *Men*, who are much inferiour to the *Angels*, produce divers things, which before were not extant, and which would never have been ſo without their Induſtry. Wherefore we muſt conclude, that *Angels* will be much more able to do ſo,

This

To the Worshipfull William Bridgeman
of the Citty of West- minster Esqr one of
the Clarks of their Majestyes most
Honourable Privy Councill &c.

This Plate is humbly Dedicated by Richard Blome

G. Freeman Inv. I. Kip. Sculp.

To the Worshipfull S.r William Holford of
Welham in the County of Leicester Knight.
descended from the Antient Family of
the Holfords of Holford in Cheshire.

This Plate is humbly Dedicated by Richard Blome

VII. *Magicians, by the help of Devils, produce Animals.*

This is prov'd, becauſe *Magicians*, by the aſſiſtance of *Devils*, have produced ſome *Animals*, as *Frogs*, *Serpents*, *Dragons*, *&c.* So the *Scriptures* tell us that the *Magicians* of *Egypt* turn'd their *Rods* into *Serpents*, Exod. *Chap.* 7. Now that theſe were true *Serpents* appears hence, becauſe the *Scripture* tells us, That the *Serpent* into which *Aaron*'s *Rod* was turned, devoured the *Serpents* of the *Magicians*: For otherwiſe we muſt acknowledge, that *Moſes* his *Miracles* were meer *Impoſtures*, and falſe *Appearances*.

VIII. *The Reaſon why Man cannot produce ſome Animals, proceeds from the unſuitableneſs of the Matter.*

If you ſay, That we cannot rightly argue from the *Natural Perfection* of *Angels*, that they have *Power* of *producing Animals*; ſince we ſee that *Men*, who by many degrees excel *Mice*, *Gnats*, *&c.* yet cannot produce or generate them.

I Anſwer, That this Impotence in *Man*, does not proceed from his *Inability*, but from the defect of *Matter*, proper for the procreating of ſuch *Animals*. For every *Body* cannot be framed of every *Matter*, but of ſuch only as *Nature* hath appointed for that purpoſe. For as a *Stone-Cutter* can do nothing without *Sand* and *Stone*, tho' he hath the Power of *Squaring* and *Poliſhing* them; ſo ſeeing that *Man* is deſtitute of fit Matter for the *Generating* of *Animals*, it is no wonder that he cannot produce them. Neither doth it oppoſe this, that divers *Plants*, *Fruits*, and *Flowers*, do ariſe from the *Seeds* that Man caſts into the *Earth*: For if a *Man* had the *Seeds* of *Living Creatures*, and committed them to places ſuitable to their *Nature*, he would produce proportionate *Animals* from thoſe *Seeds*. We may conclude therefore, that *Angels* underſtanding the Virtues of *Herbs*, *Juices*, *Metals*, *Animals*, and *Men*, may take whatſoever is required to the Compoſition of *Bodies*, or *Animals*, and diſpoſing the ſame in a fit place, produce or procreate them.

IX. *Angels cannot Create.*

But tho' *Angels* may produce *Material Subſtances*, yet can they not *create* them, nor *Spiritual things*. For it implies a Contradiction, that a *Creature* ſhould produce any thing out of nothing; *Creation* being an Operation to which nothing concurs, ſave only the *Efficient Cauſe*; but if an *Angel* could create another, this Definition would not hold good; becauſe the produced *Angel* would either totally depend on the Producing *Angel*, or would own *God* alſo for his *Firſt Cauſe*. If the firſt; we muſt be forc'd to admit ſomething Independent in the World, beſides *God*, and ſo *God* would not be the *Firſt Cauſe*. If the ſecond; ſince this Productive *Power* in the *Angel* would be ſubordinate to *God*, the Effect would not be attributable to him, but to the *Primary Cauſe*.

X. *How we are to underſtand that the Efficient Cauſe can produce its own like.*

You will ſay, That a Perfect Efficient can produce its own like; as *Fire* can produce *Fire*, a *Lion* generate a *Lion*; and that therefore an *Angel* being more perfect than any Material Thing, can produce another *Angel*; not indeed by *Generation*, becauſe an *Angel* is a *Simple Being*, not conſiſting of Parts, but by *Creation*.

XI. *Anſwer.*

I Anſwer, That this Maxim of *ARISTOTLE* has no place in *Thinking things*, but only in *Material*, which are ſubject to Corruption, whoſe Property it is to preſerve their *Species*, by the multiplication of *Individuals*: Whereas *Angels*, being exempt from *Corruption* and Materiality, have no need to preſerve their *Species* by *Propagation*.

CHAP. VI.

Of the Number, Diſtinction, and Subordination of Angels.

I. *The Number of Angels is very Great.*

'Tis certain from *Holy Writ*, that there are vaſt multitudes of *Angels*, which tho' they be ſometimes expreſs'd by a certain number, *Dan.* 7.10. *Thouſands of Thouſands miniſtred unto him, and ten Thouſand hundred Thouſands aſſiſted him.* Revel. 5.11. *And the Number of them was, Thouſands of Thouſands*; yet they cannot be reduc'd to any determinate Number. For ſince *Great* or *Little* are only Comparative Terms, and no Number can be called the greateſt, but in compariſon with a leſſer; the Multitudes of the *Angels* muſt be *compared* with ſome other Multitude, that by the Exceſs of either we may find out which is the greater.

II. *According to ſome, the number of Angels far exceeds the number of Men.*

Hence ſome are of Opinion, That the number of *Angels* is very great, if compar'd with the number of *Men*, that are, have been, or ſhall be; ſince it is not probable that *God* hath left ſuch vaſt and magnificent Spaces without *Inhabitants*, except only the *Empyreal Heaven*: And becauſe it ſeems probable to them, that the more *Perfect Beings* ſhould exceed the leſs Perfect and Ignoble, in bulk or quantity, if they be *Extended*; and in Number, if *Spiritual*.

III. *But without any cogent Reaſon.*

This *Argument* would indeed conclude ſomething, in caſe the *Angels* were *Extended Beings*, and took up place; but being *Intellectual* and devoid of Matter, they cannot fill any Space. Nor is the Reaſon that ſupports this *Argument* of any ſtrength: For if it were generally true, that things more Perfect muſt exceed the leſs Perfect in Number, I know no reaſon, but that upon the ſame account it might be concluded, that there muſt be more *Gods* than one; more *Suns* than *Planets*; more *Pearls* and *Precious Stones*, than *Common Stones*; the firſt of which is contrary to *Faith*, the ſecond to *Reaſon*, and the third to *Experience*.

IV. *The Opinion of the Talmudiſts, concerning the Number of Angels.*

The *TALMUDISTS* reduce the *Angels* to certain *Numbers*, diſtributing them into ſeveral *Companies* or *Bodies*, and aſſigning to every one of them a ſet number (as it were) of Inferiours, as *Subjects* or *Soldiers*. For according to *R. F. Georgi* the *Venetian*, of the *Order* of St. *Francis*, the *Talmudiſts* diſtribute the Armies of the *Angels* into *Mazaloth*, *El*, *Legion*, *Rihaton*, *Chirton*, and *Giſtera*. *Mazaloth* they ſay are Twelve, according to the XII Signs of the *Zodiack*. *El* are thirty *Bands* or *Regiments*, for every one of thoſe Twelve; and accordingly there are 360 *Bands* of *Angels*. *Legion* multiplies this Number of 360 by 30; whence doth ariſe the Number 10800. And this Number they multiply again by *Thirty*; which makes up *Rihaton*, conſiſting of *Three Hundred and Twenty five Thouſand*; which multipyed by *Thirty*, makes *Chirton*, conſiſting of *Nine Millions*, *Seven Hundred and twenty Thouſand*. Which they multiply again by *Thirty*; the Product whereof is *Giſtera*, conſiſting of *Two Hundred and Ninety one Million, and Six Hundred Thouſand*. The Sum Total of them all being, *Three Hundred and One Million, Six Hundred Fifty five Thouſand, One Hundred Seventy two*, as appears in the ſubjoyned Table.

12	12 *Mazaloth.*
30	360 *El.*
360	10800 *Legion.*
30	324000 *Ribaton.*
10800	9720000 *Chirton.*
30	291600000 *Gistera.*
324000	3016551 72 *Banns or Regiments of Angels in all,*
30	
9720000	
30	
291600000.	

Whether the *Talmudists* have truly assign'd this number of the *Angels*, cannot be decided by any evident reason: Wherefore we may conclude with St. *Gregory* on the 26. of Job, *Humane Reason cannot assign the Number of the Superiour Spirits: because it doth not know the Multitudes of those Invisible Beings.* And a little after, *The Number of the Spirits or Citizens above can only be counted by God, but are Innumerable, as to Men.*

V. *All the Angels are not of a different Species from each other,*

As to the Difference of *Intelligences*, the *THOMISTS* are of Opinion that all of them differ *Specifically*, and that Intellectual nature is their *Genus*. Their Reason is, because they make Matter the *Principle* of *Numerical Distinction*, and therefore suppose that all *Immaterial Things* must differ Specifically. But this is a mistake, forasmuch as *Numerical Distinction* doth not arise from *matter*, but from the *Essence* it self of every thing whereby it is Distinguisht from others. According to this Axiom, *Form gives the Being to a thing*, or *Essence* is that whereby a thing is principally known and differenc'd from others. *SCOTUS* therefore calls singular *Essence Hæcceity*. For who will say that two *Modes* in the same *Body*, or two *Perceptions* in the *Soul*, differ specifically only because they are without Matter? Besides, two *Humane Souls* are immaterial, their notion involving nothing besides *Cogitation*; and yet no *Body* ever asserted their *Specifical Distinction*: And why may not *Angels* as well differ only Numerically under the same *Species*, forasmuch as no Diversity is found in their *Nature*, which consists in *Cogitation*, nor any so great Distinction with Relation to their several *Offices*? For most of them have like *Offices*, and a common Operation. And therefore it is not to be question'd but that many of the *Angels* are of one *Species* and differ only Numerically.

VI. *Nothing hinders but that there may be many Species of Angels.*

Yet for all this, there may be many *Species*, for ought we know amongst the vast number of *Angels*, especially amongst those who are of a Different *Order* and *Hierarchy*. And this we shall be easily persuaded of by considering the several *Quires* of *Angels*, which seem to differ, as in their *Dignity* and *Offices*, so in their *Essence* also. For these *Functions* being proportioned to their several Natures, prove their different condition. Moreover, as the *Beauty* of this visible *World*, consists much in the Different Species of *Bodily Things*; so likewise we may with more reason conclude that the Invisible *World* is adorned and Beautified with the Diversity of *Spiritual Natures*. Tho' indeed this is a matter we cannot absolutely determine, whether the *Angels* differ *Specifically*, or only *Numerically*, and therefore must say with *Damascenus*, *That he only knows this who hath Created them.*

VII. *The Immense multitude of Angels is distributed into three Hierarchies.*

There is without *Question* an *Order* and *Subordination* amongst the *Angels*, which some call a *HIERARCHY*: This is a Greek Word and signifies *a Sacred Rule or Principality*; or a company of *Sacred Princes*, who with some Subordination constitute one *Body*. This *Hierarchy* is commonly said to be twofold, *Ecclesiastical*, or *Heavenly*; the *Ecclesiastical* consists of *Prelats*, Priests and *Ministers* of the *Church*; but the *Heavenly Hierarchy*, is the whole Multitude of *Angels*, which is divided into three *Hierarchies*, viz. the superior, which by *FLUD* in his *Philosophy*, is called *EPIPHANIA*, to which belong the *Seraphims*, *Cherubins* and *Thrones*; the middle-most, or as he will have it, *EPIPHONOMIA*, which contains *Dominations*, *Virtues and Powers*; and the Lowest or *EPHIONIA*, which consists of *Principalities*, *Archangels* and *Angels*; to all which he assigns several *Offices*. The First of these, because of their most pure *Essence*, he places before *God*, as his *Assisting Ministers*: The second he makes to preside over the *Celestial Spheres*, and to have the Dispensing of their Influences to the inferiour *World*: The Third he makes the Superintendents over *Sublunary things*, as being *Spiritual Creatures* diffus'd through *Bodies*, and Destinated to the Quickening and Moving of them, and are therefore call'd *Ministring Spirits*.

VIII. *The Three Hierarchies explained.*

But because our forementioned *Doctor* writes very Enigmatically, so as to stand in need of an *Interpreter* rather than a *Reader*, I shall endeavour to give a short Explication of every one of these *Hierarchies*. The *First*, *Hierarchy* therefore is so called from the Relation they have to *God*, as being, as it were, his *Grandees* and Honourable Prime *Ministers* and *Officers*, who being nearer to *God*, receive his Commands from his Mouth and impart them to Inferiors. They who are the *highest* in this *Hierarchy* are called *Seraphims*, that is, *Burning* or Flaming, from the fervour of Divine Love Burning in them; being *most pure* themselves, and greatly purifying others, and wholly aspiring to things that are on high. The *Middle* Order is that of *Cherubims*, so called from that Transcendent knowledg of all *Divine Mysteries*. The *Lowest* is that of *Thrones*, who as so many immovable Seats receive the Rayes of *Divine Glory*, and without any motion of their own, abandon themselves wholly to *God*.

IX. *The Offices of Angels of the Second Hierarchy.*

Dominions, who are the first Order of the *second Hierarchy*, preside over those things that are to be done by Inferiour Natures, and by disposing and ordering of them, bear sway in the Government of *Humane Affairs*. *Virtues execute with a masculine and unshaken Fortitude whatsoever they are charg'd with*, as *Dionysius* expresseth it, *Hierarch. cap.* 18. *Being always ready and prepared to perform the Divine will*. Those that are call'd *Powers*, resist *Devils*, and restrain their power, from setting upon Men, and from Tempting them beyond their strength.

X. *The Properties of the Third Hierarchy.*

The Third Hierarchy also hath its particular Properties. *Principalities* are destinated to have the superintendence over *Princes* and *Prelats*: *Archangels* over *Kingdoms*, *People* and Provinces; and Lastly, *Angels* have the care of particular *Persons*,

ſons, and are as it were *Miniſters* and *Meſſengers* between *God* and *Men*. Whence it appears that there are Nine *Quires* or Orders of *Angels*; *Seraphim*, *Cherubim*, *Thrones*, *Dominions*, *Vertues*, *Powers*, *Principalities*, *Archangels* and *Angels*. The *Talmudiſts* alſo agree in the ſame Number, tho they call the ſeveral Orders by other names.

CHAP. VII.

Whether Angels be in a Place.

I. *What Place is, and how many fold.*

BEfore we reſolve this *Queſtion* it will be neceſſary to Enquire what *Place* is, and how a thing is ſaid to be ſomewhere. *Place* is commonly taken for that ſpace in which things are; and it is twofold, either *Internal*, which is nothing but the ſpace it ſelf that every *Body* occupies, and which does not differ from its Extenſion, but by our manner of conceiving it, in that *Extenſion* in a ſpace or place is conſider'd in general, and as common to the *Air*, *a Stone*, *a Book*, &c. whereas in *Bodies*, that are ſaid to be in *Space*, Extenſion is only conſider'd Individually, and as Inſeparable from them. Therefore as a *Body* conſider'd in General conſiſts of three *Dimenſions*; ſo *place* is a Space Extended, according to the foreſaid Dimenſions; ſo that whereſoever there is a *Body* there muſt alſo of neceſſity be a *Space* or *Place*. *External* Place is the ſame with *Internal Place*, ſave only in that it denotes over and above the *Situation* and *Order* it keeps amongſt other *Bodies*; and is properly nothing elſe but the ſurface of a *Body*, that ſurrounds another *Body*, and which with reſpect to the *Body* it ſurrounds, is no more than a *Mode*, ſince it cannot be underſtood without the Conception of a *Body*.

II. *Angels are not in a Place.*

Theſe things being premis'd, I anſwer to the *Queſtion*, that *Angels* and all *Spiritual Subſtances* have no place, neither *Internal* nor *External*. Becauſe to be in a *Place* is the Affection of a *Body*, and therefore *Angels* being *Incorporeal*, and without any *Extenſion*, they cannot take up any place; and if they fill no Space, what *Situation* or *Order* can they have as to other *Bodies*? Wherefore *Spiritual things* can no more be ſaid to be in a *place*, than they can be ſaid to be of ſuch *a Colour*, *Taſte or Smell*, which denote *Bodily Modes*. So that to ſay that a *Thinking Subſtance* can become menſurate to a *Space*, is the ſame as if one ſhould aſſert it to be material.

III. *How we are to Underſtand that common ſaying, that Every thing that is, is ſomewhere.*

You will ſay, if *Angels* be not contained in any *place*, then they muſt be nowhere, which is contrary to that *Axiom* of *Philoſophy*, that *Whatſoever is, is ſomewhere*; *and that whatſoever is nowhere doth not exiſt at all*: But *Angels* do exiſt, therefore they muſt be in ſome place.

IV. *Anſwer.*

I anſwer, if by *Nowhere* you underſtand no Space Meaſurable by *Longitude*, *Latitude*, and *Profundity*, it may be admitted that *Intelligences* in this ſenſe are nowhere, as being devoid of all *Dimenſions*. But if by *nowhere* you mean, that *Immaterial* Beings do not exiſt at all, this cannot be admitted, foraſmuch as in this ſenſe they are *ſomewhere*, that is, they do exiſt. For it is not neceſſary that every thing that exiſts ſhould be comprehended in ſome *Space*, this being only proper to Extended *Beings* or *Bodies*. Yea, even the whole Univerſe, containing the Infinite Expanſion of all *things*, is not comprehended in any *Place*, but is *every where*, that is, we can imagin nothing that doth encloſe and ſurround it. And therefore the Category *Ubi* is only Attributable to the particular *Bodies* of which the Univerſe doth conſiſt, not to the Univerſe it ſelf.

V. *Angels being without Extenſion, cannot be ſaid to be in a Place.*

Foraſmuch therefore, as the *Angels* are deſtitute of all *Extenſion*, and do not concur as Parts to the Conſtruction of the *Viſible World*, as particular *Bodies* do, therefore neither can they be ſaid to be ſomewhere, that is, to take up ſome *Place*. For we are to avoid the perverſe *Cuſtom* of Common *Philoſophers*, who apprehend all things after a *Bodily* manner; by Attributing ſome kind of *Extenſion* unto them. And yet nothing appears more clearly to our Mind, than that *Cogitation*, which Conſtitutes the Nature of an *Intellectual Being*, is devoid of all *Extenſion*, and hath no commerce at all with Matter. Foraſmuch therefore as *Space* in its Conception Involves *Extenſion*, it is evident that it cannot be Attributed to *Spirits*.

VI. *How Angels can be ſaid not to be ſomewhere, ſeeing they are Finite.*

If you urge further, that *Angels* are *limited Beings*, which cannot be preſent to all places; and that which is not every where, is comprehended in ſome *Space*, and anſwers to the Determinate part of the *Divine Immenſity*; and that therefore the *Angels* are in ſome certain *place*.

VII. *Anſwer.*

I anſwer, that this *Argument* is true in one *Senſe*, and falſe in another. It is *true* as to the *Firſt Part*, that *Angels* are *Finite Beings*, as to their *Eſſence* and *Operation*, ſeeing that they are *Creatures*, that depend on their *Creator* both as to their *Conſervation* and *Production*. Yet can they not be ſaid to be *finite* as to *Quantity*, becauſe they are devoid of all *Extenſion*, and in that regard are neither *Finite* nor *Infinite*, and neither take up all *places*, nor are ſhut up in one certain *place*, foraſmuch as to be *Extended*, and to be in a *place*, are one and the ſame *thing*.

VIII. *How the Angels are contained in the Divine Immenſity.*

It is true alſo, as to the *Second Part*, that the *Angels*, as all other *Creatures*, are contained in *Gods Immenſity*; becauſe his *Immenſity* is nothing elſe, but his *Omnipotence*, by which he is preſent to all his *Creatures*, Producing and Preſerving them, as has been explain'd at large in the foregoing part. So that this *Omnipreſence* in *God* is nothing elſe but an *Extrinſecal Denomination* ſpringing from *Gods Operation*, which he works in all *Created Things*. But it is falſe that the *Angels* anſwer to any part of the *Divine Immenſity*, if the *Divine Immenſity* be conceived under the notion of *Infinite Extenſion*, including an Infinite *Quantity* of real or Virtual *Parts*: for ſeeing *God* is moſt *Simple* and free from all manner of *Extenſion*, he cannot be Co-extended to the many *Parts* of the *World*, nor fill any real or Imaginary Spaces.

IX. *The Angels are ſaid to be ſomewhere by their Operation only.*

Foraſmuch therefore as *Angels* do take up no places, and cannot be ſaid with reſpect to their *Subſtance* to be *Here*, *There*, *or Every Where*; it remains that their *preſence* is only determinable by their *Operations*. And this ſeems to follow from the Nature of an *Intellectual Creature*. For ſeeing that the *Angels* are *Active Beings*, and that the life of *Active Exiſtency* conſiſts in Operation, we can only ſay that they are there, where they Operate, *viz.* in a *Body*, or about a *Body*. For ſince things are ſaid to be *ſomewhere* according to their own Proper *Nature*, *Matter* being an Unactive Lumpiſh thing, is *Paſſively* Conſtituted in a *Place*

according to its *Length*, *Breadth*, and *Depth*: whereas a *Spirit* is said to be *somewhat Actively*, viz. by that force and Efficacy, whereby it governs and moves the *Body*, and carries it from one *Place* to another; and so is said to be present to that *Body* in which, and about which it immediately works.

X. *The Soul by its Operation is present to the Body.*

Accordingly in the *Fifth Part of this Institution* it will be declar'd that the *Soul* of *Man* is peculiarly present to the *Conarion* or *Glandula Pinealis*, Situate in the midst of the *Brain*; forasmuch as it Operates, and immediately exerts its *Powers* in the same. In like manner the *Divine Immensity* is deduced from his Operation about this *World*, so that before this Operation he could not be stiled *Immense*, no more than he could be called *Creator*, before ever he had Created any thing: Forasmuch as, according to what hath been said before, *Immensity* denotes only a respect between *Created Things*, and *Gods Operation* about them. And upon this account it is that when we *pray* to *God*, we assign his proper place in *Heaven*, because he there exerts his most wonderful *Operations*, and more Efficaciously manifests his *Power*.

CHAP. VIII.

How Speech is attributable to Angels?

I. *Speech is twofold.*

NOtwithstanding that *Angels* are simple *Beings*, and do not consist of *Soul* and *Body*; yet most *Metaphysicians* Attribute *Speech* to them, whereby they are capable of conversing with one another. For that is not only call'd *Speech*, which is performed by the outward *Organs* of the *Body*, but also that inward *speaking* of the *Mind*, whereby it *thinks* or *perceives*; according to that Expression of the XIV. Psalm. *The Fool hath said in his Heart, &c.* and suitable to that way of *speaking* we so frequently use, when we say to others *What saith your Heart to this or that?* And of this manner of *Speech Divines* are to be understood, when they enquire whether *Angels Speak*, and make known their Conceptions to one another.

II. *'Tis not necessary that Angels should speak to one another.*

This *Question* may be resolv'd from the Third *Chapter*; for seeing that *Angels* penetrate each others *Thoughts*, and Voluntary Determinations, they do not seem to need *Speech*, because this is only requisit for Communication, and mutual *Society*. For there are four things required to *Speech*. *First*, that it be free, according to the will of the *Speaker*. *Secondly*, That it be discovered only according to his intent and likeing; so as to reveal secrets to those to whom it is directed, and conceal them from others tho' present. *Thirdly*, that the *Speaker* be able to excite him whom he is about to *speak* to, tho' he may be busied about other *thoughts*. *Fourthly*, That he that *hears* may know from whom the *Speech* procceds.

III. *Angels cannot speak according to these Conditions of Speech.*

But how shall the *Speech* of *Angels* be Free, when their *thoughts* are always open to others? and seeing it is not in their *Power* to conceal their *thoughts* from others? How will they be able to chuse their *Auditors*, so as not to open their *Secrets*, but to whom they please, since it is not in their *Power* to hide them, and that their *Perceptions* are as Natural as their *Substance*? Moreover how will they be able to excite their *Auditors* to the understanding of what they have to *say*, since they have nothing new to manifest to them? Lastly, how shall the *Auditor* know him that *speaks* to him, and Distinguish him from others, if he be not call'd upon, and if from his knowledg nothing accrue to him? Wherefore we must conclude that *Angels* do not discourse together after the manner of *Men*; but that they so understand each others Conceptions, as that nothing is hid from them. Whence *Divines* tell us that *the Language of Angels is their Understanding*.

IV. *Some Scriptures explained which attribute Speech to Angels.*

Neither is it any contradiction to this, what the *Scripture* mentions of the *Discourse* and *Speech* of *Angels*, as that of the 7th of the *Revelation*, where an *Angel* is said to *call with a loud Voice to the four Angels*; and in the 6th of *Isaiah* tis said that *the Seraphims cried one to the other and said*, &c. And the *Apostle* saith in the 13 *Chapter* of the first Epistle to the *Corinthians*, *If I speak with the Tongues of Men and Angels*, &c. because the *Speeches* here spoken of are *Visionary* and only seem'd to be utter'd by the *Angels*. For *Spirits* do not discourse together by an outward *Voice* formed in the *Air*; neither do they discover their *thoughts* as we do by any outward *Organs*. Therefore these *Speeches* were seemingly heard by the *Prophets*, for their *Illumination*, and that Posterity *Reading* their *Writings*, might be acquainted with those *Mysteries*, and be assur'd of them by their *Testimony*. As to that Expression of the *Apostle*, who *Attributes Tongues* to *Angels*, this must not be understood of those *Internal Speeches* which *Angels* use amongst themselves; but of those which *Angels* in former times used amongst *Men*, to manifest their Conceptions unto them, which tho' they were known and understood by *Believers*, yet served only to strike *Unbelievers* with *Wonder, and Astonishment*. And that this is the Genuine Sense of the *Apostle* in this place, appears from the *Words* immediately following, *and have not Charity, I am become as sounding Brass, or a Tinkling Cymbal*; which is only applicable to outward *Speeches*, that is, to *Sounds* and *Voices* utter'd by *Bodily Organs*, which we know cannot be fram'd by *Angels*.

V. *The Manner how the Angels speak is inexplicable.*

Neither indeed can it be shewed, how *Angels Speak* or *Discourse*, since it may be question'd whether the *signs* wherewith they express their *Thoughts* be *Spiritual* or *Corporeal*. And again, whether those *Signs* be Natural, or Voluntary. Whether all *Angels* make use of the same *Signs*, or every one of them have *Signs* peculiar to themselves. How it comes to pass, that when one Angel *speaks*, all the rest (without any difference) do not hear his *Speech*? By what Artifice their *Communication* may be hindred? Whether against their Will they perceive the *Speeches* of others; or whether their *Consent* be required to the perception of them? Whether *Angels* can reveal their *Thoughts* to some, and hide them from and impose them upon others? Which things, and many other such like, cannot be attributed to these *Heavenly Spirits*, and therefore prove their Conversation to be different from ours.

VI. *Superior Angels inform the Inferiour of things unknown to them.*

It remains therefore, if *Speech* be attributable to *Angels*, that the same only belongs to *Superiour Angels*, with respect to such as are *Inferiour*: For seeing that *Speech* is the manifestation of something unknown, if any New thing be discovered to them, it must proceed from the *Superiour Angels*. Wherefore *Divines* admit *Illumination*, which is a kind of *Speech*, to be amongst *Angels*, whereby they

they reveal unknown *Truths*, received from *God* to one another. And accordingly *DAMASCENUS* tells us in his *Second Book of Faith*, Chap. 3. *It is evident that all the Superiour and higher Angels, do impart their Light and Knowledge to the Inferiour.* So that a more excellent *Angel* is as a Light to those that are under him, to illuminate them, and communicate new *Knowledge* to them.

VII. *Sometimes this Order is changed.* But tho' this manner of *Illumination* be the most ordinary and best agreeing with the *Angelical Orders*; yet it is not necessary that it should always be after the same way: For without doubt *God* may manifest a Mystery to some *Inferiour Angel*, which by him may afterwards be communicated to the Superiour; and accordingly some think it probable, that *God* communicated his purpose of being *Incarnate*, only to the *Archangel GABRIEL*, who was to carry the Message of it to the *Blessed Virgin*; notwithstanding that he belonged to the *Inferiour Hierarchy*. But according to the ordinary course, the *Superiour Angels* Speak, and the *Inferiour* Hear and Listen; the former, as *DIONYSIUS* tells us, being the *Guides* and *Teachers* of the latter.

CHAP. IX.

How Angels assume Bodies, and what Actions they exert in them.

I. *Apparitions of Angels have been very frequent.* IT cannot be question'd, but that *Angels* and *Devils* do really appear, and take up *Bodies* to make themselves Visible; this being a thing abundantly confirm'd by Profane and Sacred *History*. Thus the *Devil*, in the appearance of a *Serpent*, Tempted *Eve*, Gen. 3. *Three Angels appeared to Abraham*, Gen. 18. *Two Angels came to* Sodom, *Gen.* 19. The Angel *Gabriel* appeared to the *Blessed Virgin*, and brought her the Message of the *Divine Incarnation*. Neither can these *Apparitions* be ascribed to the Power of Imagination, or some Melancholy Humour, forasmuch as these *Bodies* can be felt, and manifest themselves by *Corporeal qualities*. Seeing therefore we cannot doubt of the Truth of these *Bodies*, it remains only to enquire, what kind of *Bodies* are fit for this use, and what Actions *Angels* exert in them.

II. *What kind of Bodies Angels do assume.* As to the first of these Enquiries, it seems probable that the *Angels* chiefly assume *Aery Bodies*, which they form by their own *Power*, and adapt them to their Intention; so as that from the Different Disposition of the *Parts*, Variety of Colours do arise, and the *Figure* of a *Man* or *Beast* be represented to the *Beholder*. For these *Bodies* having real Extension, and being variously terminated, may according to the various *Reflexion* or *Refraction* of *Light* appear of another *Figure*, *Situation* and *Bulk*, than indeed they are. In this manner, the *Devil*, according to the Relation of *William of Paris* in his last part of the Universe, deluded a *Souldier*, by assuming the *Dead Carkase* of a *Beast*, who supposing himself to have enjoyed a Beautiful *Young Woman*, found himself, in the embraces of a loathsome rotten *Carrion*: Which sort of Delusions are peculiar to *Devils*, who Understanding the Nature of *Bodies*, and being skill'd in Perspectives, can so order the matter, as to make things appear quite otherwise than they are.

III. *Angels can appear without Bodies.* Tho' this be the receiv'd Opinion amongst *Divines*, that *Angels* and *Devils* can assume true *Bodies* in order to their appearing to *Men*; yet I do not see but that they may visibly shew themselves without the taking up of *Bodies*. For seeing *Bodily things*, as *MAGNANUS* tells us in *his Philosophy of Nature Cap.* 33. have no other Power of Acting, than that of moving or resisting *Local Motion*, it will follow, that they appear to our *Senses* either by the Motions they impress upon them, or by their resisting of other *Motions*. Wherefore since we understand that a *Spirit* can exert all those *Motions* on our *Senses* which any *Bodily Substance* can, and likewise resist other Motion as well as any *Body* whatsoever; we may likewise conceive how a *Spirit* may be perceived by our *Senses* under the Corporeal Form of that *Body*, whose Manner and Measure of Motion, or Resistance of Motion, he shall purpose to imitate. Wherefore an *Angel* in Order to his appearing will not need to make himself a Body of such a *Colour*, *Figure* and other *Qualities*, as he intends to appear with; but it will be sufficient, if he only Refract and Reflect the *Light* in such a Manner and Measure, as that *Body* would, in whose shape he desires to appear.

IV. *How an Angel can make a sound to be heard.* In like Manner when an *Angel* has a mind to make himself *heard*, it will be sufficient, if he only so beat and agitate the *Air*, as that *Sounding Body* would do whose *Sound* or *Voice* he designs to imitate. For by this means the Agitated *Air*, will communicate the Motion it hath receiv'd from the *Spirit* to the *Drum* of the *Ear*; and consequently will perceive a *Sound* like to that which the *Body* would have caused. And by this means an *Angel* or Soul may at pleasure appear to one *Person*, and hide himself from another, which would be impossible for them to do, after having assum'd an *Aerial Body*; because such a *Body* would indifferently appear to all.

V. *Supposing Angels to assume Bodies, what they do with them, and work in them.* But forasmuch as both *Angels* and *Devils* do sometimes assume true *Bodies*, as hath been shewn from *Holy Scripture*, we are next to enquire how they are present to these *Bodies*, and what they *Work* in them.

VI. *Angels are not so intimately joyn'd to the Bodies they assume, as Souls are to their Bodies.* *Angels* are not in *Bodies* after the same Manner as *Souls* are, so as that the Motions of the assumed *Body* and *Spirits* should follow the Voluntary Determinations of the *Angels*, and that the *Angels* also should be affected by the *Bodies* assumed. For herein doth the Union of *Spiritual* and *Bodily Things* consist, as shall be shewed in the ninth part of this *Institution*. Because it is one thing for a *Spirit* to be present to a *Material thing*, and another to be united to the same: Whenever a *Spirit* is joyned to a *thing*, he is also present with it; but not on the contrary; for a *Spirit* may be present with a thing and yet not be united to it. Now that conjunction which is between an *Angel* and his assumed *Body*, is not much unlike that, whereby the *Master of a Ship* is present to his *Vessel*, a *Coach-man* to his *Coach*, and a *Rider* to his *Horse*. For as the *Master* of a *Ship* may leave it, and return to it again at his pleasure; so the *Angels* may when they please quit their assumed *Bodies*, and remove into others; which they could not do, in case they were substantially united to them, as *Souls* are to the *Bodies* they animate. And as many *Pilots* may be in the same *Ship*, so more *Angels* or *Devils* than one may be in the same *Body*, as appears from the *Gospel*;

Goſpel; but many *Souls* cannot be joyned to the ſame *Body*. The *Soul* is frequently againſt its Will united to a *Body*, and cannot at pleaſure be ſeparated from it, whereas an *Angel* is never unwillingly join'd with the *Body* it aſſumes. We conclude therefore that *Angels* are only accidentally, and as aſſiſting Forms join'd to the *Bodies* they aſſume.

VII. *Angels exert no Vital Actions in Bodies.*

From what hath been ſaid, it is evident what *Angels* can perform in the *Bodies* they take up, and what Actions they exert in them; for it is manifeſt that they can produce no *Vital Operations* in them; for tho' they be willing to *Eat* or *Drink*, yet are they never troubled with *Hunger* or *Thirſt*; and tho' they really *Eat* and *Drink*, yet have they no *Senſe* of it; and the like may be ſaid of other *Corporeal pleaſures*, which no more affect the *Minds* of *Angels*, than that of *Eating* or *Drinking*. For all theſe ſuppoſe the union of a *Spirit* with a *Body*; and do not ſo much belong to the *Mind* as to the *Body*. For he who reſolves for *the Love of God* to abſtain from *Eating*, hath no will to *Eat*, becauſe he is otherwiſe determin'd; and yet frequently feels the gnawing of his *Stomach*, and *dryneſs* of his *Throat*, and a natural deſire to *Eat* and *Drink*. And in like Manner *Venereal pleaſure* belongs to the *Animal* and *ſenſitive life* we have here, but not to the life we ſhall enjoy hereafter: *for in the Reſurrection*, as the *Scripture* ſaith, *Mankind ſhall be like the Angels, in Heaven and neither Marry, nor be given in Marriage*. Matth. 22. 30.

VIII. *Devils cannot generate.*

Whence it appears, that it is altogether irrational what ſome aſſert, that *MERLIN* was begot by a *Spirit*; that the People called *HUNNI* were begotten by *Satyres* on the Bodies of *Gothick Witches*; or that *CORCOTON* a *Dæmon* in *Hiſpaniola*, was us'd to beget on the *Bodies* of *Women*, Births in the ſhape of *Men* with *Horns* on their *Heads*. Theſe and ſuch like *Stories* I take to be meer *Fables*: For ſeeing that *Devils* are *immaterial*, they can neither yield any Matter fit for that purpoſe of themſelves, nor take it from any other *Body*, foraſmuch as it is a part of the *Living Body*, and the remainder of the beſt concocted Aliment.

CHAP. X.

Whether there be any Order amongſt the Devils; and what kind of Order that is.

I. *Since Angels have different Offices, there muſt be ſome order amongſt them.*

FOraſmuch as the *Devils* are deputed to different *Works*, and according to *TRITHEMIUS* his Opinion, are ſent abroad into divers parts of the *World*, they muſt of neceſſity obſerve ſome Order, and ſomewhat imitate the *Government* that is amongſt the *Angels* of *Light*. For ſeeing they perform various *Offices*, and inhabit the *Fire*, *Air*, and *Earth*, as alſo the *Waters* and *Bowels* of the *Earth*, and that in perpetual Darkneſs; it does not appear how they could be kept to their ſeveral *Tasks* and *Duties*, if there were not ſome dependence between them, and if they did not derive their Power from one *Head*. Wherefore, *LUCIFER* in *Holy Writ* is called the *Devil*, becauſe he is the *Prince* of all the *Devils*: And accordingly when the *Phariſees* told our *Saviour* that he caſt out *Devils* by *Beelzebub* the Prince of *Devils*; he replies: *If Satan be divided againſt himſelf how ſhall his Kingdom ſtand?* By which *Words Chriſt* himſelf ſuppoſeth that there is a Primacy, and conſequently a Government amongſt *Devils*.

II. *The Power that Angels have, is not proportion'd to their Perfection.*

The only difficulty here is to explain wherein the mutual ſubjection of the *Devils* is founded. Some fix it in the different Perfection of *Devils*, as ſuppoſing them to be endued with *Power*, according to the Proportion of their *Dignity*. But this ſeems to be ſaid without ſufficient ground; for there ſeems to be no Connexion between *Natural Perfection*, and *Command* or *Moral Præeminence*, except that the one ſhould neceſſarily follow from the other; or that one ſhould be the Rule of *Manners*; neither of which can have place in the *Devils*; for otherwiſe an Inferiour *Angel* would have as many *Commanders* and *Rulers*, as there are *Angels* more perfect than himſelf, which would be a moſt miſerable State of Slavery, and Incomparably worſe than any other.

III. *The Commonwealth of Devils is eſtabliſht by their mutual conſents.*

It ſeems more Rational to conclude that the Form of their *Commonwealth*, hath proceeded from themſelves, and been eſtabliſhed by their mutual conſent. For tho' the *Devils* be exceeding Proud, and each of them hath Ambition enough to aſpire to be *Governour* in chief; yet becauſe they are full of *hatred* againſt *God* and the *Envy* they bear to *Mankind*, they ſuppoſe they can take no better way to *Rob God* of his *Honour* and to deſtroy the *Souls* of *Men*, than by mutually agreeing to ſubmit themſelves to a *Government* ſetled by *Laws*. Wherefore the *Devils* choſe *Lucifer* the firſt Author of the *Rebellion*, to be their *Prince*, as *Robbers us'd* to do, who having join'd themſelves together, chooſe one from amongſt themſelves to be their *Captain*.

IV. *The Devils are divided into Nine Orders, like the Angels.*

But what kind of *Government* the *Devils* have amongſt themſelves, is not eaſily Determinable, except we aſſent to them who divide the *Devils* into three *Hierarchies* and nine *Quires*, like the *Angels*. For ſo *CORNELIUS AGRIPPA in his third Book of Occult Philoſophy* tells us, *that there are Divines, who diſtribute the Devils into Nine Ranks, as ſtanding in Oppoſition to the Nine Angelical Orders*. Whoſe Opinion he follows and ranks them ſo himſelf.

V. *The Firſt Order of Devils.*

The Firſt Order of *Devils* according to *Agrippa*, are the *PSEUDOTHEI*, or *Falſe Gods*, who Uſurping the name of *God*, preſume to be worſhipt like *God*, and to have *Sacrifices*, and *Adorations* made to them; like that *Devil*, who ſaid to *Chriſt*, *All theſe things will I give thee, if thou wilt fall down and Worſhip me*, ſhewing him all the *Kingdoms* of the *Earth*. And the *Prince* of theſe is he who ſaid, *I will aſcend above the height of the Clouds, and will be like the moſt High*; and who is therefore called *Beelzebub*, that is, the old *God*.

VI. *The Second Order.*

The *Second Order* are the *Lying Spirits*, ſuch as he was that entred the *Prophets* of *Ahab*, and was a *Lying Spirit* in their *Mouths*. And the *Prince* of theſe is the Serpant *PYTHON*, from whence *Apollo* is called *Pythius*, and that *Woman Pythoniſſa*, 1 *Sam.* 28. as alſo that Other in the *Acts* of the *Apoſtles*, *Chap.* 16. This ſort of *Devils* make it their buſineſs to delude Men by Ambiguous or falſe *Oracles*, *Divinations*, and *Predictions*.

VII. *The Third Order.*

The *Third Order* of them are *Veſſels of Iniquity* which are alſo called *Veſſels* of *Wrath*. Theſe are the Inventers of all *Wicked Arts*; ſuch as was the

Devil

To William Benge of
Cosely Wood in Wadhurst in
the County of Sussex Gentleman
This Plate is Humbly Dedicated by Rich: Blome

G. Freman Inv.

To William Edgell of Clapton in the
Parish of Hackney in the County of
Midelesex Gentleman.
This Plate is humbly Dedicated by Rich: Blome

Devil THEATUS mention'd by *Plato*, who taught Men to *Game* and *Play* at *Dice*; for from these all *Crimes* and Wickedness do proceed, according to that of *Jacob*, *Gen.* 49. 5. where detesting the cruel Massacre committed by his Sons *Simeon* and *Levi* upon the *Sichemites*, he saith, *Vessels of Iniquity are in their Habitation: O my Soul come not thou into their Secrets*, &c. The Psalmist calls them *The Vessels of Death*; Isaiah, *the Vessels of Fury*; Jeremy *the Vessels of Wrath*, and Ezekiel *the Vessels of Murther and Destruction.* Their Prince is *BELIAL*, which signifies without a Yoke or Disobedient, and is mentioned by St. *Paul* 11. *Cor.* 6. 15. where he saith, *What Concord hath Christ with Belial?*

VIII. *The Fourth Order.* Those of the Fourth Order are called *Avengers of Wickedness*, whose Prince is *ASMODEUS*, the Executioner of *Justice.*

IX. *The Fifth Order.* The *Devils* next to these are *Juglers*, so called, because they imitate *Miracles*, and assist *Magicians* and *Witches*, seducing the People by their seeming *Miracles*, as the *Serpent* seduced *Eve.* And their Prince is *SATAN*, of whom it is written in the *Revelation*, that *he deceives the whole world, working great Miracles, and causing Fire to come down from Heaven in the sight of Men, and deceiving the Inhabitants of the Earth, by the wonders he doth.*

X. *The Sixth Order.* The *Sixth Order* are those that are called *the Powers of the Air*; these are very busie in *Wonder* and *Lightning*; they corrupt the *Air*, and cause the *Plague*; and of this Number were those, of whom the *Revelation* mentions, that it was given to them *to hurt the Earth and the Sea.* And their Prince is *MERIZIM.* This is the *Noon-Devil*, the *Burning Spirit*, and the *Devil* that rageth at *Noon*; whom St. *Paul* in his *Epistle* to the *Ephesians* calls *The Prince of the Powers of the Air, the Spirit that Works in the Children of Disobedience.*

XI. *The Seventh Order.* The *Seventh Rank* or Order is that of *Furies*, the sowers of *mischief* and Dissension, of *Wars* and *Devastations*; whose Prince in the *Revelation* is called *APOLLYON*, and in Hebrew *Abaddon*, that is, the *Destroyer.*

XII. *The Eighth Order.* In the eighth Order are *Accusers*, whose Prince is called *ASTAROTH*, that is, a Spie; and in Greek *Diabolus*, that is to say a *Slanderer*; who in the *Revelation* is called *the Accuser of the Brethren, who accuseth them before the Face of God, day and night.*

XIII. *The Ninth Order.* The last Order of *Devils* are those that are called *Tempters*, or *Lyers* in wait, who do accompany Men continually to tempt them to *Evil*, and are therefore called *Bad Angels.* Their Prince is *MAMMON*, that is, *Lust* or *Concupiscense.*

XIV. *This Ordination of the Devils is not to be respected.* And tho' this Ordination of the *Devils* be no where else to be found but in *Agrippa*, yet is it not therefore to be the less esteemed, seeing that it imitates the Orders of the *Good Angels*, and is derived and descends from *Lucifer* the Prince of the *Apostate Spirits*: So that as *God* hath his *Angels*, so *Lucifer* hath his *Devils.*

CHAP. XI.

Of the Care of Angels about Mankind, and the things here below.

I. *There is a twofold care of Angels.* IT is manifest that *God* makes use of the *Ministry* of *Angels*, in the Ordering of things below; and there seems to be a twofold care in them; the one *General*, whereby they are concernd for the whole *World*; the other *particular*, whereby they watch over particular *Men.* Wherefore *NAZIANZEN* in his 6*th.* Poem writes thus concerning them.

Some with most Awful looks surround the Throne,
Ready and Girt t'obey the Holy one:
Others support the World, and lend their Aid
To all the Several Creatures God hath made.
Their Care is diverse, as are Gods Commands,
These govern Men, and Those Cities and Lands.

II. *The Opinion of the Ancients concerning the Guardianship of Angels.* Accordingly the Ancients tell us of *Universal Angels*, every one of which did preside over a whole Nation, and were called the *Angels* or *Genius* of such or such a *Nation*: And of *Particular Angels* that are singly appointed to take care of this or the other particular *Person*, and are more particularly called *Genii*, because they superintend the Generation of particular *Persons*, and as soon as they are born do inseparably assist them. Such an *Angel* as this is called by *Epictetus* a Keeper, Particular Overseer, a Domestick *Spie*, a Proper *Curator*, an intimate *Cognitor*, a Continual *Observator*, an Individual *Arbiter*, an Inseparable *Witness*, a Reprover of *Vice*, and an Approver of *Virtue.* *O ye Men* (saith he in *Arrian*) *take it for granted, that every one of us is committed to the care of a certain diligent and worthy Keeper: Whensoever therefore you shall have shut your Doors upon you, and shut out the Light from you, take heed you do not conceit your selves to be alone; for most certain it is you are not so; for God is with you; and so likewise is your good Angel.*

III. *The same confirm'd by Christians.* What the Ancients called *Genii*, the same the *Christians* call *Angels*, and do own both their General and special *Guardianship.* For all *Christians* hold it for an undoubted *Truth*, that they have *Angels* deputed by *God* to be their *Keepers* and Companions, to inspect their *Actions*, to divert Mischief from them, and to take care for their *Future Bliss* and *Happiness.* For thus much may be deduced from the *Offices* of *Angels*, who, as the *Apostle* tells us, are *Ministring Spirits*, whose duty chiefly it is to put by the *Devils* Snares, to exercise *Mens Minds* to *Virtue*, to raise up such as are fallen, to suggest good advice, and to present their *Prayers* and Wishes to *Almighty God.* Indeed for this very cause they are called *Angels*, as being a kind of *Messengers* betwixt *God* and *Men*, whom they are to direct as *School-masters* and *Pastors.*

IV. *The Angelical care is deducible from the Providence of God.* In this *Angelical* superintendency, the Providence of *God* most clearly appears, forasmuch as he *governs* and *rules* these things here below, by *Superiour Powers*, and *Administers* changeable *things*, by such as are *Spiritual* and unchangeable. *For as by the Prudence and Forecast of a Good Emperour* (saith *Chrysostom*) *all Cities, Towns and Castles, are furnisht with sufficient Garrisons against any Hostile Invasion, and all places so provided with Arms, that they may not stand in fear to be laid waste by a Barbarous Incursion: In like manner God, because the Devils with Barbarous and cruel minds are always hovering about us to overthrow our peace and happiness, appoints for our Safeguard the Hosts of his Angels, that by their presence, the stout boldness of the Devils may be repress, and the Grace of Peace vouchsafed to us.* For *Angels* are, as it were, the *Protectors*

of Men, ſpecially deputed by *God* for their Safety: Not as if *God* were unable to ſave them; but as a *King*, who orders his faithful *Officers* to cruſh the Deſign of his *barbarous Enemies*, and to Chaſtize the *Inſolence* of his *Subjects*.

V. *The ſame confirmed by Scripture.*

Scripture alſo confirms the ſame to us: *Do not deſpiſe one of theſe Little ones* (ſaith our *Saviour*,) *for their Angels continually behold the Face of my Father which is in Heaven.* Wherefore it nearly concerns us always to continue in the *Fear* of *God*, as being certain that we have *God*'s *Angels* about us, who obſerve all our *Thoughts* and *Actions*: And whenever we do that which is good, we cauſe great *Joy* to our *Angels*; whereas, if we do *Wickedly*, we drive them with grief away from us, and make way for the *Devils* to come to deceive and enſnare us.

VI. *The Effect of the Guardianſhip of Angels.*

We ſee therefore that the Aſſiſtance of *Angels* is of great advantage to *Men*, by procuring them much *Good*, and by diverting many *Evils* both from their *Souls* and *Bodies*. They greatly aſſiſt our Minds, by enlightning our *Underſtanding* to perceive *Truth*, and by exciting our *Will* to the exerciſe of *Vertue*, and to embrace the *Good* that is offered to us: They alſo put by many *Evils* which threaten our *Bodies*, whether from *Natural Cauſes*, or from *Free Agents*, as from *Men* that are our *Enemies*, and from *Devils*; and prevent them from hurting thoſe, whoſe Safety they take to heart. Sometimes alſo they ſend *Sickneſs* and *Adverſity*, to correct Mens *Vices*, and thereby to reduce them to a ſober and ſound *Mind*. Yea, and ſometimes may inflict *Death* alſo, and that in great Kindneſs; foraſmuch as it may be very profitable and neceſſary for ſome to be taken out of the *World*, leſt being overcome by the *Vanities* and *Luſts* of this *World*, they ſhould run themſelves into *Perdition*.

VII. *The Superintendence of Angels, extends it ſelf alſo to Countries and Cities.*

As there are *Special Angels* conſigned to the *Guardianſhip* of *Men*, ſo there are others who have care of *Cities* and *Countries* committed to them, who, as ſo many *Preſidents*, or *Lords Lieutenants*, do watch over them for their Good. And as a whole Nation doth in *Dignity* far exceed every particular Member of it; ſo do the *Angels*, that preſide over a whole *People*, excel thoſe who have the Care only of ſome particular *Perſon*. Now that *Nations* have their *Guardian-Angels* alotted them, is moſt evident from *Scripture*, Deut. 32. 8. *When the Moſt High divided to the Nations their Inheritance, when he ſeparated the Sons of* Adam, *he ſet the Bounds of the People according to the number of his Angels*, as the *Septuagint* expreſſeth it. Wherefore the *Ancient Fathers* believed, that the *Archangels* had the Care committed to them of the Government of the *Univerſal Church*. Thus we read that *MICHAEL* fought with the *Dragon*, ſtood up for the defence of the People of *Iſrael*, is the *Provoſt* of the *Church*, and aſſiſts particular *Angels*. What is more clear in *Scripture*, than that *GABRIEL* was ſent with a Meſſage to the *Bleſſed Virgin*, about the *Salvation* of *Mankind*? and that *RAPHAEL* was ſent to Succour *Iſrael*, and to exhort them to the *Fear* of *God*? All which are evident Teſtimonies of the *Publick Miniſtry* and *Adminiſtration* of *Angels*.

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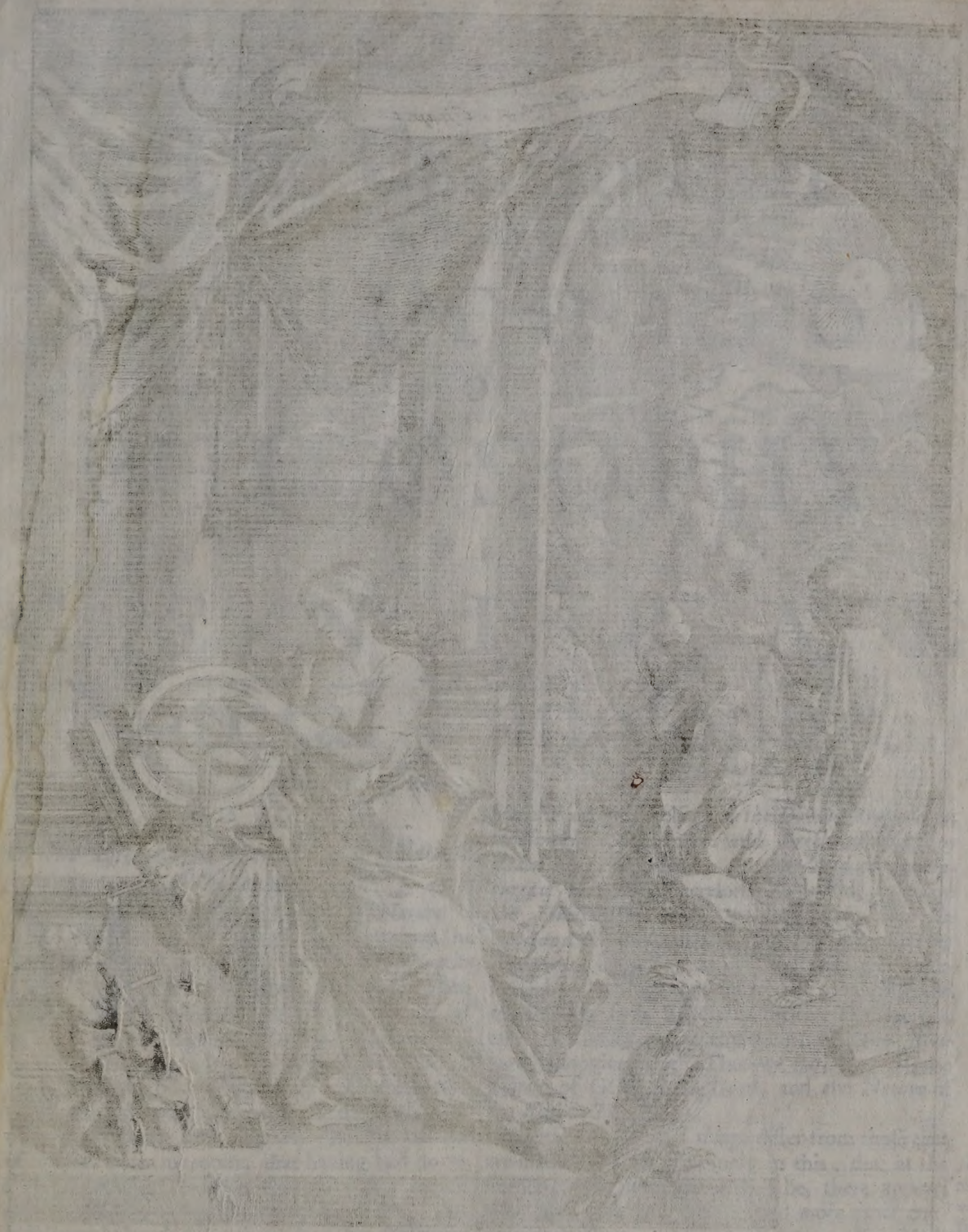

G. Freman Inv. *I. Kip Sculp*

To the Worshipfull Thomas Drax of Sibsy in the County of Lincolne Esqr.

This Plate is humbly Dedicated by Richard Blome

The Fourth Part
OF THE
INSTITUTION
OF
PHILOSOPHY.
VIZ.
GENERAL
Natural Philosophy.

CHAP. I.
Of the Essence and Certainty of Natural Philosophy.

I. *What Natural Philosophy considers.*

HAving considered the *Nature* of GOD, and enquired into his *Attributes*, as far as *Human Weakness* would permit, and afterwards examin'd the *Essence* of *Angels* and *Devils*, and discovered their *Faculties* and *Operations*; PHYSIOLOGY comes next to be considered by us, which contemplates *Natural Things*, and deduceth their *Causes* from their *first Original*. For the Order of *Nature* seems to require, that having laid down a *Supream* and *Universal Principle*, we should next proceed to the examining of its *Effects*, that *Affections* belonging to them may be discovered to us.

II. *What Natural Philosophy is.*

Natural Philosophy therefore, or *Physiology*, is *the Science of Natural Bodies, and their various Affections.* And therefore is called *Natural Philosophy*, because it enquires into the *Essence* of *Material things*, and treats of their *Properties*, *Accidents*, or *Modes*: And those are called *Natural Things*, or *Bodies*, which are endued with *Nature*, or that are compounded of *Matter* and *Form*, which are the inward Principles of their *Activity*, *Passibility*, and *Cessation*.

III. *The Word NATURE taken in a threefold Sense.*

The Word NATURE is of various Signification: First, and more strictly, it is taken for the peculiar Disposition of *Parts* in some particular *Body*: For when we say, that it is the *Nature* of *Fishes* to *live* in the *Water*; it is the same as if we said, that the Disposition of their *Organs* is such, as makes the *Element* of *Water* most suitable to them. *Secondly*, It is taken more largely for the Universal Disposition of all *Bodies*: And in this Sense it is nothing else, but *the Divine Providence, forasmuch as it governs and directs all things by certain Rules and Laws, accommodated to the Natures of things.* Wherefore *God* is said, to *cloath the Lillies of the Field*; to *send Rain upon the Good and the Bad*; and to *give Food to all living Creatures*; because, that by the *Rules* by him prescribed, all things conspire to the producing and maintaining such Effects as these. *Thirdly*, It is taken for the *Essence* of any thing, with the *Attributes* belonging to it: Thus we say, that it is the *Nature* of GOD to be *Good*, and the *Nature* of the *Soul* to *Think*.

IV. *Natural things do not differ from Artificial.*

Neither do *Natural things* differ from those that are made by *Art*, save only in this, that in the former, how mean soever they be, there appears a far more excellent *Artifice*, and more exact contexture of *Parts*, than in the latter. Yet this is common to them both, that they are moved from an inward *Principle*, and perform their *Functions* by their own Virtue. For a *VVatch* or *Clock* is no less moved of it self, by the Figure of its *VVheels* and *VVeights*, than a *Ball* of *Lead* is, whilst it falls down through the *Air*, towards the Center of the *Earth*. For every Natural thing is moved by a *Motion* deriv'd from another, and doth always retain the same, till it be put by by a stronger.

V. *Physiology is a true Science.*

Now that *Physiology* is a Species of *Science*, and is conversant about things that are True and Necessary, appears from the *Demonstrations* that are made of *Natural things*; the Certainty whereof depends on the Stability of the Things that are defined, and supposeth their determinate Essence. For Example, this way of Arguing; *Every Extended thing is Divisible*; *A Body is Extended*: *Therefore a Body is Divisible*, could never be esteem'd a Demonstration, if it were not most

certain

certain that *Extension* enters the Nature of a *Body*, and that *Divisibility*, as a Property, ariseth from it. Now it is notorious, that all certain and necessary Knowledge, is *Science*; since no such can be had, but where the *Effects* are demonstrated by their true *Causes*: And that many such may be had in *Natural Philosophy*, is not to be question'd. For we know that *Matter* is moveable, because it is a *Substance* extended in *Length*, *Breadth*, and *Depth*. We know that every *Body* may be carried on from one place to another; because it implies a Contradiction, for one and the same *Body* to be in two places at one and the same time. And innumerable such like, which a *Natural Philosopher* considers as so many unshaken *Truths*, that cannot be gain-said by any Person in his Wits.

VI. *Whether Natural things be discerned by the Senses.*

If you say, That the Certainty which is required to *Science*, cannot be had in *Natural things*, seeing that *Bodies* and all their *Attributes* are only perceived by the *Senses*; which being liable to Mistake, may represent False things to the *Understanding*: Whence it is that not only *Children*, but also *Men* of Age labour under so many Prejudices, which they being unable to correct, persevere in their *Errors* to their Lives end.

VII. *Material things are not discerned by the Senses.*

I Answer, It is False that *Material things* are known by the *Senses*, as I have shewed by the Example of *Gold*, in the *Second Chapter* of the *First Part* of my *LOGICK*; forasmuch as it continues always the same, tho' it puts on divers Forms, and appears variously to the *Senses*. For if we mind well how far our *Senses* reach, and what that precisely is, which they represent to our *Minds*; we shall find, that they give us no such Notions of *Material things*, as we in our *Minds* have of them: And indeed, to speak properly, nothing is conveigh'd from things without us, by the *Organs* of *Sense*, to our *Minds*, save only some *Bodily motions*, by which the *Idea's* of *Objects* are offer'd to them. For what doth our *Sight* exhibit to us, besides outward *Images*, or our *Hearing*, besides *Voices* and *Words*? So that if we do apprehend any other thing besides those *Pictures* and *Voices*, that is, their Signification; we may be sure the same is offer'd to us, not by our *Senses*, but by those *Idea's* or *Notions* that proceed from our *Thinking Faculty*.

VIII. *But are apprehended by the Understanding only.*

Wherefore, *Bodily things* are not known by the *Senses*, but by the *Understanding* alone: So that to be sensible of a *Material Substance*, is nothing else, but to have an *Idea* of it, which is not the work of the outward *Senses*, but of *Cogitation*. Neither must this seem strange unto us, seeing that *Certainty* is required to perfect *Knowledge*, which since it cannot be had from the *Senses*, as being subject to *Error*, we must have recourse to the Certainty of the *Understanding* that may correct our *Errors*, and represent the true *Image* of the *thing* to us.

IX. *Whether the Errors occasioned by our Senses, can be corrected by our Senses.*

If you urge further, that there are many Things that cannot be corrected by our *Understanding*, except our *Senses* be first well-disposed, and that our *Mind* borrows its Certainty from them; as appears by *a Stick standing in Water, which because of the Refraction seems to be broken* or *bent*, when indeed it is *strait* or *whole*; because this *Error* is not to be corrected by the *Understanding*, but by the *Touch*: And the same may be said of the other *Senses*.

X. *Answer.*

I answer, tho' by our *Touch* we know the *Stick* to be *streight*, yet is not that sufficient to correct the mistake of our *Sight*, but there is need of a *Reason* to persuade us, that in this case we are rather to give credit to the report of our *Touch*, than to that of our *Eye-sight*; which Reason cannot be ascribed to our *Sense*, but to our *Understanding* alone. It remains therefore that the knowledge of *Natural things* depends on our *Cogitation* and that they cannot be perceived by our *Senses* such as indeed they are.

XI. *An Objection against the certainty of Bodily things.*

You will object, that *Material Things*, of which *Natural Philosophy* treateth, do not continue in the same *State*, but are subject to various changes, quitting and assuming several *Forms*, which seems to be inconsistent with the Notion of *Science*, which is the knowledge of things *certain* and *Perpetual*. For what is more common than the Rise and Destruction of *Bodies*? For all things that consist of *Matter* and *Form* are subject to *Generation* and *Corruption*, and never continue long in the same state and condition.

XII. *The Certainty of Bodily things established.*

Nevertheless we must say, that *Natural Philosophy* is indeed a *Science*, because the *Nature* of a *Science* is not consider'd with respect to the things it treats of, but according to its *Axioms* of an undoubted *Eternal Truth*. For tho' the things which *Physiology* handles, be changeable; yet the *Judgments* we make of them are stable and firm; and consequently the Truth we have of them is *Eternal* and unchangeable. As for example, these are indubitable and constant *Truths*, that *all that is Bodily is changeable*; *that every Mixt Body is dissoluble*, tho' they be of mutable and changeable things. For as the knowledge we have of Matter is Immaterial; so we may have an immutable *Science* of changeable and corruptible things.

XIII. *The Object of Physiology.*

For as much as every *Science* hath a *Subject*, about which it is conversant, and to which, whatsoever is handled in the same may be attributed either as *Principles*, *Parts* or *Affections*; we say that the *Material Subjects of Physiology*, are natural *things*; and that *Magnitudes*, *Figures*, *Situation*, *Motion* and *Rest* are the *Formal Subject* of it; as under which, *Bodily* things are consider'd, and from whence they derive their force and *Virtue*, as shall be said in the 10th Chapter. Wherefore if a *Natural Philosopher* consider nothing in Matter besides these *Divisions*, *Figures* and *Motions*, and admit nothing for *Truth* concerning them, which is not evidently deducible from common Notions, whose *Truth* is unquestionable, it is altogether manifest, that no other *Principles* are to be lookt for in *Natural Philosophy*, than in *Geometry* or *abstract Mathematicks*: and consequently that we may have as well Demonstrations of *Natural Things*, as of *Mathematical*.

XIV. *Things are consider'd here in their natural State.*

But before I proceed any further, I must acquaint the *Reader*, that I undertake nothing here but the explication of *Natural Things*; and that my only design is to explain them by their *Effects* and *Causes*, that so I may contain my self within the Bounds of the *Science* I treat of. Wherefore I openly profess, that I consider *Natural Things*, in their *Natural State*, and that my purpose is not in the least to treat of them, as they pass the Bounds of *Nature*, and are put in a *Supernatural condition*. For it would be great Rashness in me to set Bounds to the *Divine Omnipotence*, by pointing out how far

far it can go. But rather as I acknowledge *God* to be the Author of the *World* and of all *things*, so likewise I own that *Infinite Things* may be produced by him, which the mind of Man cannot reach in the least.

XV. *Natural Philosophy is either General or Special.*

Natural Things are considered two manner of ways in *Physiology*, *viz.* either *Generally* or *Specially*; and accordingly *Natural Philosophy* is Distinguisht into that which is *General*, and that which is *Special* or Particular. *General Physiology is, that which considers a Body or Matter in General, that is, its Nature, Principles, General Affections and Differences. Special or Particular Physiology is that, which considers Matter as distinguisht into Species; and doth more particularly explain the Properties, Differences and Changes of those several Species.* Wherefore we are to begin with the most simple *Principles* of *Natural Things*, and from them proceed to the *Bodies* themselves, that are made up of them.

CHAP. II.

The Existence of Material Things Proved.

I. *We may question the Existence of Bodily things.*

FOR asmuch as it is lawful to doubt of every thing, whether or no it do Exist, as long as its nature is not clearly known to us; we may also question whether *Material Substances* be, beside our *Cogitation*, and if they be, by what *Argument* this may be proved: As to which thing every one will be able with great ease to satisfie himself in this matter, only by giving heed to the Conception we have of *Bodily Things*.

II. *The Notion of a Material thing frequently occurs to us.*

No *Philosopher* ever deny'd that we have the Notion of *Material Things*; yea, if we throughly examine their *Nature*, we shall find many *Properties* in them, which would not agree to them, if they had not some Nature. For we can Demonstrate of an *Extended Being*, that it is *Moveable*, *Divisible*, *Impenetrable*, &c. For since to be extended is nothing else but to have distinct *Parts*, it cannot happen by the *Power* of *Nature*, that the parts of *Matter* should take up the same place.

III. *God can do whatsoever can be clearly known, or apprehended by us.*

Moreover, we know *God* to be *Omnipotent*, and that he can do whatsoever can be clearly and Distinctly known by us. Yea, if we will reason aright, we must say, that nothing is impossible, but because it is inconsistent with our clear and distinct perception: But we do clearly and distinctly know *Matter* to be something extended *in Length, Breadth and Depth*: Therefore *Matter* must at least be producible by *God*.

IV. *The Actual Existence of Bodily things proved.*

Nor will it be difficult to prove that this *Material Substance* doth exist actually. For tho' our *Senses* be apt to deceive us; yet we cannot doubt of all the things they represent to us. Because we dayly experience and find in our selves many *Ideas* or *Species* of *Natural things*, which must proceed from some things or other without us, that are the *Causes* of such *Ideas*. For it doth not depend on our *Wills*, that we perceive by our *Senses* one *Substance* more than another; but that difference proceeds from the *Objects*, which produce such a Sensation in us. For oftentimes these *Species* occur to us without our heeding it, and before that we think of them by any reflex *Cogitation*. Wherefore we must conclude that these *Ideas* proceed from things, which consequently must exist in *Nature*.

Lastly, there is no *Man* who doth not perceive himself to be endued with an *Imaginative Faculty*, in that he doth almost every moment conceive so various and different *things*; now the *Imaginative Faculty* considers *Bodies* as present, and is altogether conversant about *Bodies*; wherefore it is necessary in order to its perfection that *Material Things* should exist.

V. *Tho' the Senses deceive us in the manner of their representing things to us; yet not with respect to the substance of things.*

If you object, that nothing of certainty can be gather'd from the *Senses*, forasmuch as they do frequently deceive us. For we find by experience that things are represented by them otherwise than they are, as when a *Square Steeple* appears round to us at a *distance*; or when a great *Brass Ball* at the top of a high *Steeple*, shews like a little *Apple* to our *Sight*.

VI. *Answer.*

I answer, that these *Errors* do not destroy the Truth of *Material Things*, tho' our *Senses* deceive us in their representing of them. For it may happen that that which I see with my *Eyes*, is quite another thing than I Imagin it to be; yet for all that it cannot be, but that which does appear to me must be something *Material*, which is sufficient to prove the *Existence* of *Matter*; because the variety of *Figures* does not take away the *Subject*, but rather doth manifest it, and forceth us to confess, that those *things* that appear to us under divers *Figures* are something that is *Material* or *Corporeal*.

VII. *The Motions we find in our selves prove us to be Corporeal.*

Neither do those things that are within us, less evidence this *Truth* than those that are without us: For if we give heed to the *Ideas* of *things* in our *Mind*, we shall find that besides the notions of *Intimate Consciousness*, *Perception*, *Judgment*, and *Affections*, we meet with others that consist of *Extended Parts*, diversified by *Length*, *Breadth* and *Depth*. Moreover, besides these, we experience many *Motions* in our selves, as *Hunger*, *Thirst*, *Pain*, which do not belong to our *Soul*, forasmuch as it is a *Thinking Being*; for the *Soul* of *Man* being *Immaterial* is incapable of any of these, and only perceives them as she is united to a *Material Substance*. For *Pain* doth not touch our *Mind*, save only so far as it is joyn'd to the *Body*; neither can it be vexed with *Hunger* or *Thirst*, save only so far as it is link'd to the *Stomach* and *Throat*, the one whereof is pinch'd with a *Vellication*, and the other with *Drought*. So that it cannot be doubted but that there are many *Ideas* of *Natural Things* in us which are not fram'd by our selves, but come to us from abroad, and present themselves to our *Imagination*.

VIII. *If there were no material things without us, God might be thought to impose upon us.*

For as the *Philosopher* discourseth in the last *Part* of his *Principles*, *Sect.* 1. We may enquire concerning the thing which is represented to us, whether it be *God*, or something distinct from him: But because we feel, or rather by Motions impress upon our *Senses*, do clearly and distinctly perceive a certain *matter* extended in *Length*, *Breadth* and *Depth*, whose various parts have diverse *Figures*, and are tost with several *Motions*, and are the cause of Diverse Sensations in us, as of *Colours*, *Smells*, *Pains*, &c. If *God* did immediately by himself represent the *Idea* of *Matter* to our *Mind*; or if he should cause the *Idea* thereof to be represented to us, by any thing wherein there was nothing of *Extension*, *Figure* or *Motion*, this would be to impose upon us. For we clearly understand *Extended Matter*, as a thing altogether distinct both from *God* and from our selves, that is, our *Minds*; and

we clearly seem to perceive that the said *Idea* proceeds from things plac'd without us: Now it is utterly repugnant to the *Nature* of *God* to impose upon us. And therefore we must peremptorily conclude that there is really *Existing* such a *thing* as is extended in *Length*, *Breadth* and *Depth*, and hath all those *Properties*, which we do clearly perceive do agree to such a *Being*. And this is that thing which we call *Body* or *Matter*.

IX. *The Order of things to be handled hereafter.*

But forasmuch as every thing is best known by its *Essence*, *Properties* and *Affections* or *Accidences*, to the end we may have a more perfect knowledge of *Matter*, whose *Existence* we have just now demonstrated, it must be our business to prove, wherein its *Nature* doth consist, what are its *Properties* and what *Accidences* it is capable of. Accordingly we will first enquire what it is that doth *constitute Matter*, and next what those things are that do inseparably accompany it, and lastly the *Accidences* that happen to it.

CHAP. III.

Of the Nature and Constitution of Matter.

I. *What Matter is, and how it differs from a Body.*

MAtter is a *Body*, in asmuch as it is a *Body* or a *Substance* extended in *Length*, *Breadth* and *Depth*: Wherefore a *Material* and a *Bodily* thing are *Synonymous Terms*, and do not differ, save by our *Mode* of considering them. That which consider'd absolutely is call'd a *Body*; the same with regard to that which is made of it, is call'd *Matter*: As for example, this extended *Mass*, consider'd as something undivided, and indistinguisht, is a *Body*; but if referr'd to those distinct *Bodies* that are made out of it, it is called their *Matter*.

II. *This Matter doth not differ from* Aristotles *first Matter.*

This is that *First Matter* about which there are so many Squablings in the *Peripatetick School*; and is nothing else, but an inadæquate Conception of a *Body*, as it may be conceiv'd by us without any *Figure*, *Hardness*, *Softness*, *Colour*, or any other Modifications, and only as Extended, and consisting of three *Dimensions*. For the further Explication of this *Notion*, and that the agreement of the *Cartesians* and *Peripateticks* in this matter may appear, I shall add these following *Propositions*.

III. *How Matter is said to be without Form.*

The *First Proposition*: The First matter is *without form*: For in this, the Notion of *Extension* is abstracted from all Modifications, that belong to the *Essence* of a *Body*.

IV. *How it is the same in all Bodies.*

The *Second*: The *Matter* of all *things* is the *same*; for all *Bodies* agree in this first or Primary *Attribute* of a *Body*, *viz. Extension*, neither is there any Distinction between them with relation to the *Matter*.

V. *How Matter is capable of all Forms.*

The *Third*: Every *thing* may be made of every *thing*; or, according to the *Peripateticks*, *Matter* is capable of all *Forms*: For since all *Bodies* agree in *Extension*, all their difference must be from their various Modifications; if therefore there be an *Efficient Cause* sufficient to alter these *Modes*, it may make every thing of Every thing. On this *Proposition* are grounded all those *varieties* which are observed in *Bodies*.

VI. *How it is ingenerable and incorruptible.*

The *Fourth*: A *Body* as such, or the First *Matter*, *is Ingenerable and Incorruptible*: that is to say, there is no new *Substance* created; neither is the least part of Matter annihilated; for only the *Modes* are changed, in all Alterations.

VII. *What we are to understand by the word Matter.*

Physical Matter therefore, or a *Natural Body*, is a *Substance* Extended in *Length*, *Breadth* and *Depth*; neither can any thing else be represented to the *Imagination* by the name of *Matter*: For *Extension*, as hath been said, is that Primary, *Intimate*, and *Radical Attribute*, which is conceiv'd or apprehended in every *Body*, and which in all alterations continues the same, nor can it be destroyed, but by Annihilation of the *Body*. So that we must stand to it as an undoubted Truth, that *Extension* is identified, that is, is one and the same thing with *Matter*, so that how much soever is taken from *Quantity*, so much is taken away from the Body; and on the other hand, whatsoever is taken from Body, the same is taken from the *Quantity* of it.

VIII. Aristotle *doth not oppose this Doctrin in his* Metaphysicks.

Most men I know are of *Opinion*, that herein we differ from *Aristotle*, who in his *Metaphysicks* tells us, that *Matter* of it self is neither *Quid* (something) nor *Quantum* (of any *Bulk* or *Quantity*) nor any other thing of all those, whereby a *Being* is determin'd. From which words they argue that *Aristotle* supposed *Matter* to be devoid of all *Extension*, yea that it did not exist in the nature of *things*.

To which I answer, that *Aristotle* indeed makes a distinction between *Extension* and *Quantity*, which we also freely admit, because *Matter* may be conceived without *Quantity*. For he that *Measures* a piece of *Land*, immediately conceives the *Extension* of it, but doth not know the *Quantity* of it, till after he hath measur'd it. Indeed *Quantity* is nothing else but *a certain mode of Extension*, or some Measure of it, by which we answer him, who demands what the *Quantity* or *Bigness* of a *Body* is. And so *Quantity* is an *Attribute* modally distinct from *Extension*. And in this *Sense* it is not repugnant to say, that *Matter* is an extended *Substance*, and yet that it is nothing of all those things which *Aristotle* in the foresaid place removes from it; forasmuch as they cannot be understood but of *Matter* determin'd by some particular Form. Thus we cannot say that *Matter* Universally taken, and as consider'd at first view, is either *Hot* or *Cold*, that it is of such a determinate *Measure*, or that it is some particular thing, as *Wood*, *Marble*, *Gold*, &c. much after the same manner as when we consider a *living Sensitive Creature* in General, we cannot say that it is a *Horse* more than a *Lion* or any other particular *Species*.

IX. *Extension is not the Mode of a Body.*

Neither do those argue at any better rate, who distinguish *Extension* from *Matter*, and consider it only as a *Mode* of it: As for example, whilst they mind the *Extension* of a *Table*, they will have the *Extension* to be the *Mode*, and the *Table*, the *Substance* whose *Mode* it is: For these talk as absurdly, as if one hearing another discoursing of the *City of Rome*, should imagine these to be two different things, whereof the one should be the *Mode* and the other the *Substance*; or as if one should go about to distinguish *Humanity* from *Man*. For as Humanity, or the Nature of *Man*, doth not differ from *Man* generally consider'd, but only as an Abstract and Concrete, so neither doth Extension differ from a *Body* in a general acception.

X. *Why the Natural Philosophy of the Schools is so barren.*

Those therefore who deny that *Extension* constitutes the Nature or *Essence* of *Matter*, will never be able distinctly to explain what they mean by the Word

Word *Matter*, nor wherein its *Essence* doth consist: Yea, they lay that down for a *Principle*, from which it is impossible for them to deduce any Consequence, which may illustrate the *Mind* of Man, or be of use towards the discovery of any *Truth*; and therefore they must not wonder to find their *Physiology* so barren as it is, and that they have not been able hitherto to explain the least product of *Nature* by means of it.

XI. *Whether there be no more Matter in a Vessel fill'd with Gold, than in one fill'd with Air.*

But they who estimate the *Properties* of *Matter* by their *Senses*, and by them measure the *Essences* of things, argue thus against this Opinion. If a *Bodily Substance* were something indistinct from Extension, it would follow, that wherever there was found some *Proportion* of *Matter*, there would also be the same of *Quantity*: But this is found to be false in two Vessels of the same bigness, forasmuch as more *Matter* is found to be in that which is fill'd with *Gold*, than in the other which is only fill'd with *Air* or *Water*. Therefore *Quantity* is not always proportionate to the *Body*, and consequently differs from it.

XII. *Answer.*

I answer, that there is no more *Matter* in the *Vessel* that is fill'd with *Gold*, than in the other that contains *Water* or *Air*, tho' indeed there be more Hardness and Weight in the one than the other: For the *Essence* of *Matter* doth not consist in *Hardness* or *Weight*, or any other *Qualities*; for *Fire* that is subtil, and melted *Wax* that hath lost its *hardness*, is never a whit less a *Body*, than the heaviest *Metal*; and therefore Matter precisely consists in this, that it is *extended in Length, Breadth and Depth*, which is found to be equal in both Vessels.

XIII. *The Nature of a Body doth not consist in Hardness.*

Conclude we therefore, that the *Nature* of Material things doth not consist in *Weight*, *Hardness*, *Colour*, or the like, but in this only that they are Extended *Beings*. For as to *Hardness* we can deprehend nothing else of it by our *Sense*, than that the *Parts* of hard *Bodies* resist the Motion of our *Hands*, when they run against them; for if as oft as our *Hands* are mov'd towards any place, all the *Bodies* that are there should give way, and remove thence with the same *swiftness*, as our Hands advance, we should never feel any *Hardness*. Neither can it be conceived, that the *Bodies* which thus remove or give way, should therefore lose the Nature of *Bodies*: wherefore the *Essence* of *Material Things* doth not consist in *Hardness*.

XIV. *Nor in Figure, Weight, Colour, &c.*

And in like manner it may be made out, that *Weight*, *Colour*, and other such *Qualities*, which by the *Senses* are perceiv'd in *Matter*, may be taken away from it self, remaining whole as before: For suppose the *Hardness* of *Ice* melted into *Water*, to be vanished; its *Figure* also to be quite changed; suppose also that *Water* to be rarified into *Vapors*, and having quit its Bulk and *Heavineſs* to disappear from our *Eyes*, by its extreme Tenuity and Thinness; yet it is evident that the *Bodily* Quantity or *Extension*, which is the Seat and *Subject* of all these mutations, does remain entire and untoucht, and altogether inseparable from the *Ice*, the *Water* and *Vapors*.

XV. *An Objection that Matter ought to be Defined by some Relation to the Senses.*

It may be you will say, that tho' a *Body* be not bound to one *Figure*, and may be deprived of a *Cubical*, *Triangular* or *Spherical Figure*, yet must it still have some *Figure* or other. In like manner tho' a *Body* be not necessarily either *Soft* or *Hard*, *Hot* or *Cold*, yet it is necessary that a *Body* should be sensible, or as *Lucretius* expresseth it, *Tangible*.

Besides a Body, as we see,
Nothing can Touch, or Touched be.

XVI. *The First Answer.*

To which I answer, *First*, that Sensibility is only one of the *Properties* of a *Body*, and not the whole nature of it; since a *Body* may really exist, tho' there should be no Men to whose *Senses* it might offer it self to be perceived; as we know that *Matter* was created before there were any *Sensas* made. Wherefore there seems to be no absolute Necessity that every *Body* should be sensible. On the contrary, we find that there is no *Body*, which may not become insensible, by being divided into so minute parts, as not to be able to move our *Nerves*, especially if those parts be also swiftly moved.

XVII. *The Second Answer.*

I answer *Secondly*, that a *Power to affect the Senses*, presupposeth something that is extended, and is no more than a Respect, and *Extrinsecal Denomination*, which must be grounded in some Internal or absolute *Attribute*.

XVIII. *Extension only belongs to the Essence of a Body.*

Extension therefore is that alone which constitutes the *Nature* of a *Body*, as agreeing *to all*, *only*, and *always* to them, so that nothing can be perceived in a *Body* before it. For it agrees to every *Body*, to *Earthly* as well as *to Heavenly*, to *the Sun*, *Fire*, *Air*, as well as to *Wood*, *Stone*, &c. It belongs *only* to a *Body*, because no *Intellectual Substance* is Extended and Divisible. And it agrees *always* to a *Body*; because tho' all other *Attributes* be taken from it, and be changed, yet the *Extension* continues as long as the *Body* doth. Besides, nothing can be conceived in *Matter* before *Extension*; for tho' *Matter* be *Divisible* into Parts, yet that is not the first affection we perceive therein; for therefore only a thing is Divisible because it is extended.

XIX. *That Quantity seems to be encreased in Rarefaction.*

Some are of opinion that *Quantity* may be encreased, without any encrease of the *Matter*: Thus in *Rarefaction* the *Quantity* seems to be augmented, tho' the *Substance* continue the same it was; and this they endeavour to prove by a *Pot* of *Water* on the *Fire* that *boils* over; at which time they suppose the *Water* to take up more place than it did before; now it cannot take up a larger place, without a greater degree of Extension.

XX. *Rarefaction is performed, by the introduction of another Matter.*

I answer, that *Rarefaction* is not performed by an addition of *Quantity*, but by the entrance of other little *Bodies* from abroad; so that those *Bodies* are said to be rarefied, whose *Pores* being opened are filled with the *Air*, or some other *Subtil Matter* entring into them; and they become close or compact again, when by the expulsion of those *Adventitious Particles*, those Spaces are narrowed again, and the parts come closer together. For certain it is, that nothing can be encreased in *Quantity*, but that at the same time its *Extension* must be encreased also. Of which I shall treat more at large when I shall have occasion to speak of *Rarefaction*.

XXI. *An Objection from the Nature of Space.*

But you will object, that *Space* is conceiv'd to be something extended in *Length*, *Breadth* and *Depth*: Yet *Space* is not a *Body*; therefore the *Essence* of a *Body* doth not consist in *Extension*. The *Minor* is proved, for that if space were a *Body*, then one *Body* would be in another.

XXII. *Answer.*

I answer, It is false to say that *Space* is not a *Body*; because the same *Extension* which constitutes the nature of a *Body*, doth also constitute that

that of *Space*. And therefore to say that a *Body* takes up such a *Space*, is no more than to say, that it is so great a part of the *World*; because *Bodies* bring their Spaces along with them, and when they remove, carry them away with them. And when *Bodies* are said to leave their *Spaces*, it is the same as to say that they quit the *Magnitude*, *Figure* and *Situation* they had amongst other *Bodies*. Wherefore the *Extension* of *Space* doth not differ really, from the *Extension* of a *Body*, and therefore we must conclude every *Space* to be *corporeal*.

XXIII. *Tho' God be immense or Infinite, yet he hath no quantity.* And whereas some say that *God* occupies or takes up all places of the *World*, as being *Infinite*, *Immense* and *Omnipresent*, &c. which cannot be conceived without some *Extension*; this is an objection of no moment. For tho' *God* be *Omnipresent*, yet this doth not prove him to be *extended*; because by an *Extended Being* all *Men* understand something that is *Imaginable*, of a certain *Figure* and *Magnitude*; whose parts are separate from each other, so that one of them cannot be in the place of the other; which cannot agree to *God*, or any *Spiritual Substance*, as being imperceptible to the *Imagination*, and apprehended by the *Intellect* only. When we say that *God* is *extended* through all the *World*, this is not to be understood of the *Extension of Substance*, but of the *Extension of Power*, so that the meaning only is, that *God* can exercise his *Power*, sometimes on a greater, and other times on a less part of *Matter*. For if there were no *Bodies*, we could not conceive a *Space*, to which *God* should be co-extended.

XXIV. *A Natural Body is the same with a Mathematical Body.* Wherefore with our *Philosopher* I profess my self to own no other *Matter* of *Bodily things*, than that which is altogether *Divisible*, *Figurable* and *Moveable*, which *Geometricians* call *Quantity*, and which they make the object of their *Demonstrations*; and that I consider nothing in it, besides those *Divisions*, *Figures* and *Motions* which are the properties of it. And tho' such a *Body* as I have here described, be by others called *Mathematical*, yet I take it here in this *General Physiology* for a true and *Real Body*. Indeed *Natural Philosophy* is one of the parts of the *Mathematicks*, and has the same relation thereto, as *Metaphysicks* have to the other *Disciplines*; the only Difference between them is, that the *Mathematicks* consider *Magnitudes* and *Figures* abstractedly, without being sollicitous whether they be such indeed, or only can or may be so. But *Physiology* considers the same as inherent in *Matter*, and as she finds them in the several *Bodies* that are in the *Universe*. Now this Abstraction doth not at all hinder, but that *Physical* or *Natural Matter* may be the same with the *Geometrical*, because the *Species* is not really distinct from its *Genus*.

CHAP. IV.

Of the Proprieties of Extended Substance, viz. *Mensurability, Divisibility and Impenetrability.*

I. *Mensurability, Divisibility and Impenetrability are the Properties of an Extended Substance.* THere are three *Properties* which accompany an *Extended Substance* or *Quantity*, viz. *Mensurability*, *Divisibility and Impenetrability*. *Mensurability is an aptitude in a Body, whereby it may be apply'd or conform'd to a certain measure. Divisibility is that disposition of a Body whereby it is conceiv'd to have Parts into which it may actually, or by thought, be divided.* Lastly, *Impenetrability is the distinction of one Extended Being from another, by which the Extension of one thing is different from that of another; so that two things Extended cannot be in the same place, but must of Necessity exclude each other.*

II. *From the Extension of Matter we may easily infer its Divisibility.* That a *Bodily Substance* is *Mensurable* and *Divisible*, may be easily gathered from what goes before; for since it hath a threefold Dimension, *Length*, *Breadth* and *Depth*, it must also admit a threefold *Measure*, by which its *Magnitude* may be determin'd. Its *Divisibility* also may be gather'd with the same evidence from its *Extension*, forasmuch as it hath Parts placed besides one another, so that we may easily conceive them to be separable, in which the very *Essence* of *Division* consists. But because many, who follow *DEMOCRITUS*, are of opinion, that there may be *Indivisible Bodies* out of which all other things are made, it will be worth our enquiry, whether the parts that constitute *Matter*, be *Indivisible*, or such as admit of further *Division*.

III. *Every Body is Divisible.* To which I answer, that *Matter* is not compounded of *Indivisibles*, that is, of parts that cannot be divided into others. This is the opinion of most *Philosophers*, and the reason is this, because the *Essence* of *Matter* is to have parts that are extended; and whatsoever is extended, is *Divisible*. For it cannot be conceived that a thing should be Extended, and yet not be *Divisible*; because *Extension* is nothing else, but an answerableness to divers points of *Place*, and such a disposition wherein one part is distant from another, not by actual separation, but by an aptitude to be separated, which is sufficient to make one thing not to be another.

IV. *There are no Indivisible Bodies.* Moreover, *Beings* are not to be multiplied without necessity; now there is none that forceth us to have recourse to *Indivisibles*: For *Points* are not the Parts of a *Line*, but smaller *Lines*; neither are the Parts of a Surface *Indivisible* Lines, but smaller *Surfaces*; neither are the *Parts* of a *Body Atoms*, or *Indivisibles*, but *Particles* indefinitely lesser, or Divisible without end. For in things extended we can never come to the very least Part, because as long as it is extended, it cannot but be conceiv'd Divisible. Whence proceeds that *Axiom*, that *no Quantity* or Magnitude *can be made of that which is not Quantitative*. If you say that the *Terms* or extreams of Magnitude cannot be explain'd without them; I answer, that every Extended *Being* is sufficiently terminated by the negation of any further Extension: Nor do I see, what can be more requir'd to the Termination of a *thing*, than that it is no further extended. If it be said that they are necessary to joyn the Parts of *Matter*. I answer that neither are they necessary upon that account, because the Parts of *Matter* sufficiently hang together without standing in need of a third to link them together

V. *An Argument to prove Atoms.* You will *Object*, that there are some Particles in *Bodies* so small, that they cannot be divided; and without question there may be such, as *Atoms*, and the like, which can by no human artifice be made less than they are; and yet no *Body* can deny

deny these to be *Corporeal Substances*; therefore it cannot be said that a *Body* is divisible into parts that are always further Divisible.

VI. *Epicurus his* Atoms *are Divisible.*

I say it is Impossible that any *Body* should have any parts so small as to be Indivisible, because the least part or *Atome* of a *Body* is extended, and therefore cannot be Indivisible. For *Bodies* as such are Extended, without which they cannot be conceived. For suppose an *Atome* lying on a Plain, or three *Atomes* join'd together on a Plain, they must be suppos'd to have Sides, whereby they touch both themselves and the Plain, which is their Extension.

VII. *How Matter is said to be Divisible.*

Matter therefore is Indefinitely *Divisible*; that is, the *Mind* of *Man* in the *Division* of *Matter* can never come to a *Term* where it is stopt from proceeding further; for the least *Particle* will always be extended, and whatsoever is extended must therefore be conceiv'd to have distinct Parts, and what is conceiv'd to have such Parts, must be conceiv'd *Divisible*; especially if we consider that *God* can do whatsoever we do clearly and distinctly conceive. And tho' *God*, it may be, will have it so, that some *Atomes* should not be actually divided by us, yet we must not say that he hath deprived them of the Power to be divided; for we clearly understand that they can be divided by *God*, as long as we suppose them to be Extended. Therefore *Indivisibles* cannot enter the Composition of a *Body*; forasmuch as nothing is found in a *Body*, that doth not consist of *Length*, *Breadth* and *Depth*.

VIII. *Matter is Indefinitely Divisible.*

But tho' the Parts of *Matter* be always *Divisible*, so as that we can never come to the very least of them; yet doth it not follow therefore that the Parts of Matter are *Infinite*, but only *Indefinite*. For it is one thing to say a thing is Infinitely Extended; and another, to say it is only Indefinitely so. That is *Infinite* in which there are no Bounds at all, and so *God* alone is *Infinite*: Whereas those things which in some respect only have no End, are better called *Indefinite*, than *Infinite*; such as *Matter* is, which divide it never so much, will still be further *divisible*. And herein *Magnitude* differs from *Multitude*, because in the latter we come by division to a *Unity* or Indivisible; whereas in the *Division* of the former, we may still go on, and divide for ever. Because a *Body* cannot be divided into so many *Parts*, but that every one of them will still be capable of a further *Division*; and therefore these parts are said to be *Indefinitely*, extended. This will appear more clearly by an *Argument* taken from *Geometry*, because in that *Science* it can be demonstrated, that there are some *Magnitudes* which have no common *Measure*, and therefore are called *Incommensurable*, as are the *Diagonal line*, and the sides of a *Quadrangle* or *Square Figure*.

IX. *What Quantities are said to be Commensurabe.*

Two Quantities are said to be *Commensurable*, when we can find a Third, which is a Part of both the one and the other, that is to say, which measures them both. Thus a *Pace* and a *Rod* are two Commensurable Quantities, because we can name a third Quantity, *viz. half a Foot*, which will measure both a *Pace* and a *Rod*; for the half Foot taken five times, will be equal to a *Pace*, and the same Measure taken twelve times will be equal to a Rod.

But if no such third *Quantity* can be found to *measure* them both, then those *Quantities* are called *Incommensurable*. Supposing therefore the Figure A B C D to be a *Quadrangle*, it is manifest by *Geometrical Demonstration* that the side of A B is in Commensurable with the *Diameter* or *Diagonal* A B.

X. *What Quantities are Incommensurable.* Fig. 1.

Divide we then in our *Mind* the Line A B into a thousand equal Parts, and every one of those again into a thousand more, and these last again into a thousand other equal Parts. This *Division* may be continued for a hundred years, and yet shall we never be able to come to Parts so small, that we can say that the Line A C contains a certain and determinate number of them. Which could never happen so, if *Extension* could not be Indefinitely prolonged. For after the *Division*, by *Example* of the *Line* A B into the least Parts into which *Extension* could be divided, it would necessarily follow that the *Line* A C contains a certain and determinate number of them. Wherefore we must conclude that every *Extension*, or determinate *Portion* of *Matter* is Indefinitely Divisible.

XI. *The Divisibility of Matter Demonstrated.*

It may be oppos'd to this *Demonstration*, that in case all *Bodies* were Indefinitely Extended, it would follow that two *Bodies* of unequal *Magnitude*, would have an equal number of *Parts*. Yea, moreover if it be granted that one *Part* of a *Body* be Indefinitely Divisible, there will be as great a Divisibility in one part as in the whole; For Example, in *a grain of Barley* as in the whole *Field* wherein it grew. But this seems very absurd, that there should be as much divisibility in the least part of *Matter* as in the vastest quantity; wherefore Indefinite Partition cannot agree to *Extension*.

XII. *An Objection against the Divisibility of a Body.*

To which I answer in the *first* place, that they are very much mistaken who attribute *Equality* or *Inequality* to a *thing Indefinite*, these being the Properties of *Finite things* only. For how can those things be call'd *Equal* or *Unequal*, which are Indefinitely divisible, and to the least part of which we can never come? Those things only can be call'd *Equal* or *Unequal*, which we can comprehend, and compare together; but not those which are Indefinitely Divisible, and which our Mind can neither apprehend, nor compare together.

XIII. *The First Answer.*

Secondly, supposing two *unequal* Bodies, should be divided into an equal number of *Parts*, yet would it not follow thence that those two *Bodies* were Equal; because the *Parts* of one *Body*, would proportionably be greater than the Parts of the other *Body*, and therefore the Divisibility of one *Grain* would not be so great, as that of the whole *Field* wherein it grew, tho' it be Divisible into as many parts.

XIV. *The Second Answer.*

Neither it a sufficient *argument* against this, that some say they cannot comprehend how the *least* Body should be Indefinitely Divisible; for who knows not that there is a vast number of *things* which cannot be comprehended by the *Imagination*? The famous *ROHAULT* proves this by two *Examples*, very pat to the purpose, *viz.* by the Division of *Gold* which is made by the *Gold-beaters*, and the partition of the same *Gold* made by the *Wire-drawers*.

XV. *The Incomprehensibility of the Divisibility of Matter is no Argument against the Truth of it.*

For the *Gold-beaters* of one ounce of *Gold* make 2790 Square *Leaves* of *Gold*, each side of which contains two *inches* and *ten* Lines; and if we deduct hence the Wast Pieces that are cut off,

XVI. *The Division of Gold by Gold-beaters.*

which almoſt reach to one half of it, the *ſurface* of every *Leaf* of *Gold* will be found to contain 1156 *ſquare Lines*; ſo that all of them joyned together ſide by ſide, will make out a *ſuperficies* of 3155880 *ſquare Lines*. And if we add to this the Third part thereof for the Loſs in the making, it will follow that the *Gold-beaters* out of one Ounce of *Gold*, beat 4270840 *ſquare Lines*. Seeing therefore this Number includes 159092, the quantity of the *Baſis* of the *Cube* of one Ounce weight, it is without doubt that that *Cube*, which contains only five *Lines* with a Seventh part in height, is at leaſt divided into 159812 *ſquare Segments*.

XVII. *The Diviſion of Gold by Wire-drawers.*

And tho' this Diviſion of *Gold* into *Leaves* be very ſurprizing, yet is it much Inferiour to that which is performed by the *Wire-drawers*. Theſe have commonly lying by them many pieces of *Gold* of a *Cylindrical figure*, being every one of them of 16 *Marks weight*; one of the moſt regular of which pieces was ſhewed to the foreſaid *Philoſopher*, the length whereof was of two *Inches* and nine *Lines*, ſo that the *Cylindrical ſuperficies* of it was of about 12672 *ſquare Lines*: This *Superficies* being cover'd with many *Leaves* of *Gold*, which put together weighed an Ounce and an half, was through the holes of a *perforated Plate*, drawn into *Wire* of the thinneſs of an *Hair*. Of this *Thred* he took 150 Foot, which he found upon exact weighing to weigh 36 *grains*, wanting a part of a *Grain*: So that the foreſaid *Cylindrical Maſs*, at this rate, muſt make a Thred of 307200 Foot long; whence follows, that it was drawn out 115200 longer than it was at firſt, and conſequently that its *ſuperficies* did exceed its firſt length above 340 times. If we add to this, That this thin *Thred* may be beaten into a *Leaf*, and thereby obtain a *ſuperficies* twice as big as it was before, and ſo will exceed its firſt Magnitude 680 times, and conſequently make 80616960 *ſquare Lines*: And that after the whole *Thred* is thus beaten into a *Leaf*, the *ſuperficies* of it is all cover'd with *Gold*: It follows thence, that one half Ounce of that *Metal*, whoſe *Leaf* is cover'd with *Gold*, is to that degree attenuated, that the *ſuperficies* of it conſiſts of 80616960 *ſquare Lines*. Wherefore ſeeing that quantity contains 325795 times 26 *Lines*, and $\frac{2}{49}$, which is the value of the *Baſis* of the *Cube* of *Gold* of one Ounce, it neceſſarily alſo follows, that the Thickneſs of *Gold*, which covers the *gilt Leaf*, is at laſt reduced to the $325795\frac{2}{49}$ part of the half of the *height* of one Ounce; ſo that the quantity of five *Lines*, with a *ſeventh part*, hath at this rate been divided into 651590 *equal parts*.

XVIII. *Every thing that we cannot comprehend, is not therefore impoſſible.*

And laſtly, If we conſider that this *Diviſion* of *Gold* might ſtill be carried further, if the *Metal* ſo extended were not deſign'd to certain uſes, which cannot permit any further attenuation of it; as likewiſe that there are many *Agents* in *Nature*, who carry their work to a greater degree of *Subtilty* and *Tenuity*, it will ſtill appear more clearly, that that is not impoſſible which our *Imagination* cannot perceive or comprehend.

XIX. Matter *is impenetrable.*

Another property of Matter is, *Impenetrability*, which tho' Negative, agrees to a *Body*, as well as *Diviſibility*. For ſince to be Extended, is nothing elſe but to have Parts diſtinct from each other, it implies a Contradiction, that one Part ſhould take up the place of another, or that one Part ſhould be contained in the other, or (which is the ſame) that one Part ſhould be another. For it cannot be conceived, for *Example*, that the Part *A* of an Extended thing, ſhould penetrate the Part *B* equal to it, without conceiving the middle Part of the Extenſion of *A* to be taken away or annihilated; now that which is annihilated cannot penetrate another thing. Beſides, ſince any *determinate Body*, *Ex. gr.* of a *Foot long*, hath all things neceſſary to the conſtitution of ſuch a *Quantity*, there can no other *Body* of a Foot long be added to it, without making an Extenſion of two Foot: And to reduce them by *Penetration* to one Foot, is not ſo much to joyn one *Body* to another, as to deſtroy it; and therefore we muſt conclude, that *Matter* is is impenetrable, and that *Penetration* and *Extenſion* can never agree together.

XX. *Menſurability, Diviſibility, and Impenetrability are the Properties of Matter.*

Whence it is evidently deducible, that *Menſurability*, *Diviſibility*, and *Impenetrability*, are the Properties of *Matter*, becauſe they always accompany it, and can never be ſeparated from it. For that I call the *Eſſential* Property of any *Subject*, which we conceive to agree with any *Subject*, and which neceſſarily follows it: As, it is the *Eſſential Property* of a *Triangle*, that *two of its ſides taken together are greater than the third*; Or, that *three Angles are aqual to two right ones*, becauſe theſe ſo agree to a *Triangle*, as neceſſarily to accompany and inhere in the ſame.

CHAP. V.

Of the Diviſion of Matter *into Senſible and Inſenſible Parts.*

I. *Matter is divided by Motion.*

THo' *Motion* be only the *Mode* of a *Body*, and cannot be conceiv'd to be without it; yet is it ſo much conducing to the *Beauty* and *Harmony* of the *World*, that all the Matter in it would be without *Form*, if it were not divided by *Motion*, and cloath'd with thoſe *Affections* we find in the ſeveral parts of it. Hence it is the *Philoſophers* tell us, That *Nature is the Principle of Motion and Quiet*, becauſe by means thereof *Material Subſtances* acquire that variety we obſerve in them. By *Motion* Bodies get *Heat*, and by *Reſt* they become *Cold*. But when *Philoſophers* define *Nature* to be the *Principle of Motion and Reſt*, they are not ſo to be underſtood by us, as if all the variety we find in *Matter* were the effect of *Motion* and *Reſt*, foraſmuch as that depends alſo on the *Magnitude*, *Figure* and *Scituation*; but only that they are the *Principal Attributes* of *Natural Bodies*. For there is no queſtion, but that from the Beginning, *Motion* made the diſtinction of *Bodies*, and gave them thoſe *Qualities* and *Affections*, which we find in them. And hence it is, that *Senſible* and *Inſenſible Parts* do ariſe.

II. *Of Parts, ſome are Senſible, others Inſenſible.*

Senſible Parts *are thoſe, which being made up of many* Inſenſible *ones, do affect the Senſes.* Inſenſible *are thoſe, which becauſe of their ſmalneſs do not fall under* Senſe, *and are only known by their Effects, or the Diſcourſe of Reaſon.*

III. *There are Inſenſible Parts in the World.*

Neither can we doubt of the *Exiſtence* of ſuch *Parts* in the *World*, if we thröly examin the *Nature* of a *Body*, and conſider the *Inſeparable Properties* that belong to it. For every *Body* is *Diviſible*, ſo as that we can never come to the laſt *Particle* of it; though it be certain, that by continual *Diviſion*, we

we shall at last come to a part, which because of its littleness, will not be perceived by our *Senses*, and yet will not therefore lose the *Nature* of a *Body*; because as *Division* doth not constitute the Nature of a *Body*, so neither can it destroy it. Wherefore, there are Insensible *parts* in *Matter*, which none of the *Organs* of our *Senses* can give us any notice of.

IV. *Fluid Bodies consist of many Insensible Parts.*

This appears most of all in *Fluid Bodies*, which consist of such small parts that no *sense* can perceive them. Thus we see that *Flesh*, *Bread* and other *things* are spoil'd by the *Air* and *Water*; but how this is done our Reason only can inform us: for we gather from the effects that some Insensible *Particles* of the *Air* and *Water*, insinuating themselves into the *Pores* of the *Flesh* and *Bread*, do there settle themselves in a manner contrary to their constitution as to *Figure*, *Motion*, *Situation* and *Rest*; wherein the Nature of *Corruption* doth precisely consist. For we cannot conceive any *Body* to be corrupted, but by the accession of some foreign parts, which are contrary to those of its first constitution: And forasmuch as these *small particles* are not discoverable by any of the *Senses*, they may well be call'd *Insensible* Parts.

V. *All Bodies cannot affect our Senses.*

Neither is it any matter of *Wonder*, that these *Least particles* do not affect our *Senses*; because our *Nerves*, by which we perceive external things, are like to so many small *Cords*, that are Compounded of many *particles*, less than themselves, and therefore cannot be shaken by the least of *Bodies*; and consequently cannot carry external *Bodies* to the *Brain*, where the chief *Seat* of the *Senses* is. And I suppose every *Rational Man* will own, that it is much better to judge of what happens in little *Bodies*, not subject to *Sense*, suitable to what our *Senses* perceive to happen in great *Bodies*, than to invent I know not what strange things, which have no likeness at all with the things we do perceive by our *Senses*.

VI. *From our Clothes, Iron, &c. Particles proceed, which no Sense can give us any notice of.*

Besides, we do daily experience, that a *Knife* loseth certain of its small *Particles* by being *Whetted*, and that many such like wear away from our *Clothes*, neither of which are perceived by our *Senses*. For the Polishing of hard *Bodies*, and the wearing away of *Woollen-cloth* or *Silks*, is done by the loss of such Parts, as our *Senses*, by Reason of their smalness, cannot discern. Wherefore it is most certain, that there are parts of *Matter* which cannot be discernd by themselves, tho' being joyn'd with others they can make up a sensible *Body*: This being a thing easily demonstrable by the growth of *Bodies*; and is acknowledged by Divine *PLATO* in his *Timæus* in these Words: *Concerning these little Bodies, we are to conceive thus, that if they be taken singly by themselves, none of them, because of their Parvity, can be seen by us, whereas when many of them are joyned, their Bulk presently appears.*

VII. *We are to Philosophize of Insensible parts after one and the same manner.*

Wherefore we are to *Philosophize* alike of Insensible as of Sensible *Parts*. For as we own some *Bodies* to be compounded of *Parts*, actually distinct from each other, (as we see small *Dust* in *Stones*, and *filaments* in *Flesh*;) so likewise it is consonant to *Reason*, to admit other parts of the same kind, which because of their *Smalness* cannot be perceived; and their *Analogy* persuades us to Judge and Discourse of them both after the same manner: Seeing that without them, the *Qualities* and *Operations* of *Bodies* cannot be explained. For how can I apprehend the cause why *Oil* is more easily congeal'd than *Water*, without conceiving the *Particles* of *Oil* to be hooked and Branchy, which makes them more easily to cleave together, than those of *Water*? And that *Water* is more hard to congeal, because its Parts are slippery, and united together, as *Eels* are, as shall be said hereafter. And yet no Body ever discern'd either the Parts of *Oil* to be *Branchy*, or those of *Water* to be figured like *Eels*. And therefore it is evident that in Natural things, there must be Parts allowed, that are only discernible by the *Understanding* or *Imagination*.

VIII. *Insensible Parts are not therefore to be accounted Atoms or Indivisible*

Neither are we from hence to infer, that such *Particles* as these, are *Atoms*, that is, altogether *Indivisible*: For being Parts of *Matter*, they must need include *Extension*; and it implies a Contradiction, that what is Extended should be *Indivisible*; for every Extended *Being*, hath Parts distinct from each other, and consists of Divers Dimensions, which cannot be said of *Atoms* or *Indivisibles*: Neither can we conceive any *Insensible Parts* to be so solid, as not to be *Naturally Divisible*: Nor is any *Body* so compact, but that by a strong *Motion* it may be dissolved; or if we should suppose this impossible to the *Powers* of *Nature*, yet we cannot deny *God* the Power to do it; seeing there is nothing else required to the Divisibility of a *Body*, but its Extension, and that it be Subject to those *Affections* which constitute a *Body*, as hath been said before.

IX. *They are Figured.*

Moreover these *Atoms* are of several *Figures*; now whatsoever is *Figured*, must have Parts, which Parts as they cleave together, whilst they are at *Rest*, so are they disjoyn'd again, whenever there is made an impulse upon them, strong enough to overcome their *Rest*. And this cannot but happen in that hurry, wherein the *Particles* of *Bodies* are continually tost to and fro.

X. *And are Indefinitely Divisible.*

Wherefore we conclude that there are no *Atoms*, or *Indivisible Parts* of *Matter*, but only *Bodies* of an Indefinite Littleness, which are continuous, and by the interposition whereof other *Bodies* touch one another. For the *Sensible Particles* do not properly touch one another, but are rather like *Baskets* made of Twigs, which cannot be immediately united together, but borrow all their continuity from the *Insensible Parts*, by the various Inflexion and Disposition whereof they become *Contiguous*, as shall be hereafter shewn at large.

CHAP. VI.

Of the Three-fold kind of Matter, and that there are no more than Three Elements of the World.

I. *In Sciences we are to proceed from Simple things to compound.*

THe exactest *Method* of handling *Sciences*, as to my Judgment, is to deduce the thing under Examination from its first Original, and diligently to search from what *Principles* it doth proceed. This is the common way of *Philosophers*, who do not begin their *Treatises* with Compounds, but Premising things that are simple, proceed from them, to those that are compounded, and the manner how they are made up of them. This is the way used by *METAPHYSICIANS*, who beginning with

with *Entity* in common, from thence come down to a *Body*, which is its *Species*, and afterwards divide it, into a *Terrestrial* and *Celestial Body*. And the same is observed by *GEOMETRICIANS*, who do not presently consider a *Body* as it consists of three *Dimensions*, but first of all Imagin an Indivisible *Point*, which by its course or the diffusing of it self makes a *Line*, which is a *Length* without *Breadth*. Afterwards they suppose this *Line* to move croswise, whence ariseth an *Extension* bounded by *Lines*; and to this they give the name of *Surface*, which is *Length*, and *Breadth*, without *Profundity*. And lastly from these multiplied ariseth a *Body*, extended in Length, Breadth and Profundity.

II. *God did not proceed thus in the Creation of the World.*

Which way of Teaching tho' it be very suitable for the Demonstration of *Natural* and *Metaphysical Objects*; yet did not *God* make use of it in the *Creation* of the *World*. For he did not first produce an *Entity* in General, then a *Body*, and last of all *Heaven*, *Earth*, *Plants*, &c. Neither did he first constitute a *Point*, from the *Motion* whereof a *Line* might arise, from *Lines* a *Surface*, and from multiplied *Surfaces*, a *Body*. But tho' I own that the *World* in the first moment of its *creation* was perfect, and that it was not increased by vicissitude of times, yet it will not be absurd for me to establish some *Principles*, whence we may suppose that *Natural Things* have been produc'd, tho' they were not in that precise manner created by *God*. Because those things are more clearly known by us, which are deduced from a *Principle*, and by a continual vicissitude are brought forth and encrease, than such as are consider'd in an absolute state of Perfection.

III. *Physicians do the same in their treating of Plants and Animals.*

Thus *Physicians* in order to their explaining of the Generation and growth of a *Chicken*, begin with the *Egg*, and shew what parts are daily framed therein, by the Incubation or brooding of the *Hen*. And so they who examine the nature of *Plants*, begin with their first Original and Propagation, and then proceed to the considering of them in their Sprouting, Growing, Blooming and bringing forth *Fruit*. For as *ARISTOTLE* saith in his *First Book of a Commonwealth, he that takes a view of things in their First Rise, will best of all perceive the Truth of them.*

IV. *The first thing suppos'd is, that at the Beginning the Parts of Matter were divided by Motion.*

Let us suppose therefore the Matter of the Universe to be put into *Motion*, and that it was divided by *God* into *Parts*, much of an Equal *Bigness*, not round (because many round *Bodies* put together, touch one another only in a point, and consequently leave many Empty Spaces) but into *Parts* of another *Figure*, and of a mean bigness between those that constitute the *Heaven* and the *Stars*, which we suppose to be whirl'd round about their own *Centers*.

V. *The Original of the First and Second Element.*

This being suppos'd, it will be easily made out, how the *Elements* came to be; for of whatsoever *Figure* we imagine the *Parts* of the *World* to have been, so they have but several *Angles* and *Sides*, it must follow that by running against one another, their *Angles* must by degrees have been worn away, and their *Figure* thereby chang'd to Roundness. For by an *Angle* we understand nothing else, but that Prominency which hinders a *Body* from being round; which *Angles* being worn of, a *Spherical Body* must thence arise. For *Bodies*, whirld by various motions for a long time together, do at last become round, as appears in those things that are turned. And the parts of this *Matter* are called *the Second Element*.

VI. *The Matter of the First Element, fills the Spaces that are left between the foresaid small Round Bodies.*

And forasmuch as a *Vacuum* implies a Contradiction, and that all spaces are fill'd with *Bodies*, there must be some more *subtil* Matter to fill the intervals that are found between those small round *Bodies*, which is performed by those *Particles*, which like *Shavings*, are rub'd off by Motion from *Bodies*; for they being very slender and flexible, easily accommodate themselves to the *Figures* of the *Bodies* they are contiguous to. Moreover by this *Attrition* or Rubbing against one another, they have obtained a very great degree of Swiftness; so as that by the meer force of their *Motion*, they are further divided into innumerable *Particles*, and are sufficient to fill up all the little spaces left between the *Globuli*.

VII. *The Parts of the First Element are not of the same Bigness.*

Now tho' this Matter be very subtile, yet we must not think that all the parts thereof, are of the same smallness, as appears in *Sawdust*, or in *Filings*. Wherefore the lesser of those *particles* will be more easily moveable than the thicker and bigger; and the *Particles of the First Element* will move more swiftly than those of the *Second Element*: For tho' they receive their *Motion* from these latter, yet because of the ways they must run through, their *Motion* must needs be accelerated: For whilst the *Globuli* of the Second *Element* pass through streight or right-on, and open ways, they thrust those through narrow and cross ways. And indeed we find by Experience that the narrowness of Passage conduceth much to swift Motion, as we find in a *Bellows*, whence the *Air* proceeds with great swiftness, by reason of the narrowness of its *Nuzzle*.

VIII. *The Rise of the Third Element.*

But tho' most parts of the Matter be *Round*, and that the *Particles* that are worn off from them, be such as I have now described, yet we must suppose that many parts of the Matter, having been bigger, and of more irregular *Figures* than the rest, it was more easy for them to join themselves with many others, than to become round; and these are they that constitute *the Third Element*, which we may call the *Element* of the *Earth*, because the parts of it have little or no Motion, whereby they might change their situation with regard to one another; in like manner as we may call the First, the *Element* of *Fire*, because of its subtilty, and the swift agitation of its Parts; and the Second *Element*, that of *Air*, because its Parts are bigger, and less agitated than those of the First *Element*.

IX. *How it comes to pass that the Matter of the First Element, doth not encrease continually.*

But from this supposition, that the Matter of the *First Element*, did at first arise from the hitting together of the *Globuli*, one difficulty does arise, *viz.* that it seems to follow from hence, that this Matter ought to encrease continually, because the *Globuli* of the *Second* hitting one against another incessantly, must needs strike off some *Particles* from each other, and that consequently the *Sun* and *fixt Stars*, which consist of this *Element*, must be encreased continually by reason of a never ceasing affluence of new Matter.

X. *Answer.*

This Difficulty may be easily answer'd, by considering the mutual *Conversion* of the *Elements* into each other. For from the Matter of the *First Element* sometimes a thick *Body* is made, as may be seen in the *Spots* that grow about the *Sun*, and

obscure

obscure some part of its light. For if we examine their first Original, we shall find that at the Beginning, they are very thin Bodies, which repel the impulse of the *Particles* of the First *Element*, which by running against them, cleave to them, and being condensed by the Motion of the *Suns Substance*, become big and Opake Bodies. And by this means the *First Element*, is turned into the *Third*, which being afterwards dissolved, becomes again the *First Element* by acquitting its former swift agitation, and by being divided into *Particles* of Indefinite Parvity.

XI. *The Number of the Elements.* Wherefore being resolv'd to deviate from the Sentiments of the *Antients*, since we want other *Latin Words* whereby to express them, we will distinguish the Names of these *Elements* only by Numerals, and call them the *First*, *Second* and *Third Element*.

XII. *What the First, Second and Third Elements are.* By the First Element, we understand with *Des Cartes*, *a most subtil* Matter *very swiftly agitated, fluid, and keeping to no certain figure, but which suits it self to the Figure of those bodies that are about it.* By the Second *Element*, *we mean very small Globules, that is,* Bodies *exactly round and very solid, continually whirl'd about, and which do not only like the First Element, fill up the Pores of* Bodies, *but also constitute the Purest Substance of the Æther and Heaven.* By *the Third Element we understand a* Matter *consisting of thicker and* Branchy *Parts, full of Angles and unfit for* Motion, *of which the* Earth, *Water, Air, and all mixt* Bodies *do consist.*

XIII. *The Definition of an Element in General.* An *Element* therefore Generally taken, is *a Formed Primordial Matter, whence the variety or difference of Bodies takes its rise.* Or it is *a simple Body, of which mixt Bodies are compounded, and into which they are resolv'd again at last. First*, an *Element* is said to be *a Matter Formed*, because *Elements* were at first made out of *Matter*, by the Introduction of certain *Modes* into it. It is called *Primordial*, forasmuch as *Elements* are the *Principles* of mixt *Bodies*, not made of any other *Bodies*, as mixt *Bodies* are, but immediately produc'd from the Matter *from which all variety of Bodies takes its rise*, as proceeding only from the various Modification and conjunction of the *Elements*.

XIV. *These three Elements are sufficient for the explaining of all Natural things.* It remains next to shew that these three *Elements* of the *World*, are sufficient to explain all natural effects whatsoever, and that therefore there is no need of feigning any other. This will appear if we consider the several kinds of *things* in the *World*, for according to their Diversity we are to settle the Distinction of *Elements*. And seeing all Bodies may be reduc'd to three General *Heads*, just so many *Elements*, and no more are we to look for in the *World*. Now Bodies are either lucid or shining, as are the *Sun* and *fixt Stars*: and these are made of the First Element; or Transparent as are the *Heavens*, which transmit the *Rays* of the *Sun* and *Stars*; and these do consist of the second *Element*: Or lastly, *Dark* and *Opake*, which reflect the *Rays* they receive from Lucid Bodies, such as are the *Comets* and *Planets*, and these consist of gross and corner'd parts, which as we have said, do constitute the third *Element*.

XV. *Why the Sun is called Lucid, and the Heaven Pellucid or Transparent.* For it cannot be doubted but that the *Sun* and the fixt *Stars* are Lucid Bodies, as coming near the Nature of *Flame*, and exactly resembling all the *Properties* of *Fire*, and therefore they cannot consist of any other Matter save that of the first *Element*: And the *Heavens* are said to be Transparent, and compacted of the *Globuli of the Second Element*, forasmuch as by means of them they transmit the *Light* to us. Now we must not imagine that these *Globuli* or *Pellets* of the second *Element*, are immediately joyn'd together, since that implies a Contradiction; but the subtil Matter runs between them, and takes up the places they themselves cannot fill because of their roundness. The same thing being also to be observed in other Bodies which reflect the *Light*, for a great quantity of the Matter of the *first Element* doth always pierce and permeate the *Earth* and the *Planets*.

XVI. *Things compounded of the Elements.* Wherefore three sorts of Bodies are chiefly to be consider'd in the *World*; the *Sun* and the *Stars* which consist of one only kind of Matter; the *Heaven* which includes both the first and second *Element*; and the last or lowest, which contains all the three kinds of *Matter*, as the *Planets* and *Comets*.

XVII. *Objection.* You will say, it may be, that it is an Argument of Rashness and Profaneness to set down another order of conceiving of things, than *God* himself hath observed in the making of them; and that we cannot look upon things to be the effect of certain feigned *Principles* of our own which we know were *created* by the sole Command and will of *God*.

XVIII. *Solution.* I answer, that it is no Argument at all of either Rashness or Profaneness, for a *Man* to distribute those things into many parts, which he cannot conceive all together, and to follow such an order of conceiving of things, as is consentaneous to the *Laws of Nature* establisht by *God*, tho' he knows that *God* did not make use of this Order in the *Creation* of things. For otherwise not only all *Philosophers*, but *Divines* also would be found blameworthy. For do not *Divines* divide *Gods Decrees* into *many*, which notwithstanding in *God* are only one most simple act? They link divers *Decrees* in a certain order together, and suppose some of them to have been before, and others after, tho' indeed there never was any such Series or Connexion of *Decrees* in *God*. But who has ever undertakn to blame them for this? Except it be some of those, who that they may seem to be wise, will not stick to find fault with *Heaven* it self. Now if this may be done without blame in the *Decrees of God*, which are *God* himself; much more will it be lawful for us to conceive the Universe of *Bodily* things (which is different and diverse from *God*, and made by him in the space of six days) as successively springing from certain *Elements* by the wise and Powerful disposing of *God*. And the rather, because if *God* had will'd to produce this *World* successively from *Elements*, doubtless he might have done it, without any prejudice to his Power or Wisdom.

XIX. *The Elements of the Chymists.* The *Chymists*, accounted by some the only *Philosophers*, and *Natures Secretaries*, hold five Principles, *Mercury*, *Sulphur*, *Salt*, *Caput Mortuum* or *Dead Earth*, and *Phlegm*; there being scarcely any *Body* out of which they cannot produce these several *Natures*, as they tell us. For that by the means of *Fire*, or some other *Analogous Agent*, they can so resolve things, that by separating the parts, whereof they were compounded, they can discern their several *Forms* and *Quan-*

lities. Wherefore the more subtil part which they draw off by *Fire*, they call *Mercury*, *Spirit* or *Aqua vitæ*; the Thicker and Fatter part they call *Oil* and *Sulphur*; and the most fixed, which is last of all extracted, they name *Salt*. Besides these there remains behind a certain *terrestrial matter*, being the dregs or dross of the Resolved *Body*, which they term the *Caput Mortuum*, or *Damned Earth*; and a watry and insipid liquor they call *Phlegme*.

XX. *The Principles of the Chymists cannot be said to be first Elements.*

These *Principles* of the *Chymists*, cannot be said to be the First *Elements* of things, as not being those things into which *Bodies* are resolv'd last of all, but such as proceed from them by a prior Resolution, after which they may be yet further resolv'd into much more simple parts, as the most experienced *Chymists* do confess. It hath been prov'd by a late Experiment, that *a thick Oil* distill'd from various *Plants*, hath been so rectified by many reiterated *distillations*, that at every Rectification an equal Portion of Common *Water* hath been added to it: And after many *Distillations*, they have got from it a quantity of *Water*, impregnated with much volatile *Salt*, besides a considerable portion of *Earth*, so that at last only a little *thin Oil* remained, of a great many *ounces*; which by more Rectifications might have been wholly resolved into *Phlegme*, *Volatile Salt* and *Earth*. So that neither the *Burning Spirit* of *Wine*, nor *Oil* it self, nor *Sulphur*, can be reckon'd amongst the *first Principles of things*, as being only secondary Concretions, which depend on such as are more simple.

XXI. *The Extracted Salts, are not simple.*

Neither can I persuade my self that the *Salts* extracted out of the *Ashes* of *Plants*, &c. are so simple as not to consist of some thing more simple than themselves. For when I consider that *Sea-fish*, which for a great part, are nourished with *Salt-water*, have not the least taste of *Salt*; and on the contrary that *Men* and *Beasts*, who do not so much feed on *Salt Things*, do void Salt *Urine*, *Sweat*, and sometimes *Spittle* too, I am very apt to persuade my self that *Salt* it self is not the first concretion of *Parts*, but only a secondary, and which depends only on a *Mechanical* contexture.

XXII. *The Chymists do not, in this their Enumeration, comprehend all Principles.*

These *Principles* therefore, notwithstanding they are so highly valued by the *Chymists*, do not comprehend all things out of which *Bodies* are compounded: For tho' they extract *Waters* by their *Distillations*, that is, the most slippery and flexible parts of *Bodies*, which they ascribe to *Mercury*: *Oils* also, that is, those Branch-like Parts that do easily entangle and hang together, which they attribute to *Sulphur*; and the remaining very thin parts, that are easily mixt with *Water*, and incorporate with it, which they refer to *Salt*: Yet all this while they make not the least mention of that subtil Matter, whose Existence we have here owned and asserted, and which is of absolute necessity to the composition of most natural things.

XXIII. *The Parts of Bodies are greatly changed by Distillation.*

Moreover, who would own those things to be the *Principles* of *Natural Bodies*, which are quite changed, and have got another nature? For *Fire* being extreamly active, cannot extract the parts of any compound, without violently agitating, and dividing them into less *Parts*, which Division cannot happen without a change of their *Figure*, and by consequence of their *Nature*. Now Experience proves that the nature of things is alter'd by *Distillation*; because that after all the *Parts* into which a mixt *Body* can be resolv'd, are put together again, that which thence ariseth is not the same with that it was before, but is quite of another Nature.

XXIV. *According to the opinion of the Chymists there are more than five Elements.*

We may add this also, that the *Chymists* deceive themselves by making only *five Elements*; because according to the Method and way whereby they have found out these, they may procure a vast greater number of *Elements*, yea such as the *Mind* of *Man* cannot reach. For the same *Mercury* is not drawn from all *Bodies*; nor the same *Sulphur*, seeing that which is drawn from *Wine* is very different from that they get out of *Oil*. Neither is it the same *Salt* they extract from all *Plants*, since that of the *Ash* hath a Caustick Virtue, which the *Salt* of *Oak* hath not. Wherefore we must conclude that *Mercury*, *Sulphur* and *Salt* are no *Elements*, because Elements are simple, and common to all mixt *Bodies*.

XXV. *The Chymical Principles presuppose a certain Texture of Parts.*

Moreover it is very probable that these five *Principles* do only differ by the Texture of their parts; neither do I think that *Oil* differs from *Spirit*, save only in this, that the Parts of *Oil*, are by a long Fermentation, divided into smaller parts, and furnisht with lesser branches, whereby they are less apt to adhere to *Bodies*, and with more ease flee away from them. That it is so indeed, we may conclude from this noted Experiment, that from *Plants* and *Juices* much *Oil* is got before *Fermentation*, but very little *Spirit*; whereas if you distill them after *Fermentation*, you shall have much *Spirit*, but a very small quantity of *Oil*.

CHAP. VII.

There are no Substantial Forms really distinct from Bodies.

I. *What the Peripaticks understand by substantial Forms.*

THey that follow *ARISTOTLE*, or rather his *Interpreters*, do all agree in this, that there are *Substantial Forms*, which together with the Matter constitute one Compound. By the name *Substantial Form*, they understand a certain *Substance united to matter, which together with it constitutes a meer Bodily compound.* Tho' both these parts are *Bodily* and *Divisible*, yet they assign a difference between them; as that the Form is more a Substance than the Matter, because they consider it as Subsisting by it self, and is therefore by them called *Actus* or Actuality; whereas they will have the *Matter* to be only *Potentiality*, which is perfected by the Form, from which also it derives all its *Existency*. Upon which account *Matter* is frequently call'd by *ARISTOTLE* a *Non-Entity*, a *Non-Quiddity*, and *Non-Quality*.

II. *There is no thing new in Nature which is not made by God.*

Tho' this Opinion be commonly approv'd of in *Schools*, and that they are accounted no less than *Hereticks* that reject it, yet Reason obligeth us to depart from it, and publickly to profess that *Substantial Forms* are of no use in *Natural Philosophy* for the explaining of the *Principles* or causes of natural things; yea, that all *Natural Effects* can better be explained without them. And the chief reason that persuades us to explode these *Substantial Forms*, is from their own nature. For there can be no substance that begins to be in the *Nature of Things*, which is not *created* by *God*; forasmuch as every thing, both as to its *Essence* and *Existence* depends on him; so that if there be any thing

thing that begins to be, we may truly say of it, that it is produc'd by *God*: But many *Substantial Forms* according to them do daily exist anew, and yet are not suppos'd to be created of *God* by those that admit them; therefore there is no ground at all for them.

III. *Substantial Forms can neither be produc'd nor annihilated by a created Agent.*

To confirm this; what becomes of *Substantial Forms*, when they are separated from *Matter*? Do they still continue, or do they perish? If they continue, whither do they betake themselves? What is their *Virtue*, or how do they work, being separate from *Matter*? If they *perish*, as all do own, by what force are they destroy'd or annihilated? Since *Annihilation*, as well as *Creation*, belongs to *God* alone; and that it is only the *Work* of an *Infinite Agent*, to reduce an *Existing Thing* to *Nothing*? For every single thing, always continues in the same state, except it be alter'd by an *External Principle*; now it is repugnant to the Goodness of the *Creator* to produce things, that have in themselves the *Principle* of their own *Destruction*.

IV. *There is no instance in Nature of Annihilation.*

And after all, none of the Asserters of *Substantial Forms*, can produce one single Instance that ever any *Substance* was wholly destroy'd; but will of its being chang'd into something else, and taking a new *Figure*. 'Tis for this cause only that the *Rational Soul* is said to be immediately *created* by *God*, because it is a *Substance*. For a *Material Accident*, according to their Opinion, is not *Created*, but produc'd from the Potentiality of the *Matter*, after the manner of *Substantial Forms*; wherefore, since these *Substantial Forms* are not suppos'd to be *created*, neither ought we to think them to deserve the name of *Substance*.

V. *These Forms being obscure nothing can be proved by them.*

This may also be proved another way. For *Substantial Forms* were only invented by the *Peripateticks*, to make out the *Causes* of all *Actions*, that are found in *Natural Things*, whereof they are the *Principles*, from whence they do proceed: But these *Forms* are of no use to the explaining of all these *effects*; seeing that they themselves own them to be *hidden*, and that their *virtues* are not known to them. For whatsoever is clearly perceiv'd in *Bodies*, the same according to them is deny'd to be the *Form*, which they say lies hid in *Bodies*, and which they own to be imperceptible by the *Mind* it self. Wherefore when they say that some *Action* proceeds from *Substantial Forms*, they may well be reproach'd for having recourse to a *Principle* of *Actions*, the nature whereof they do not conceive, and by consequence neither can any thing of certainty be gather'd from it: Which alone, in my Judgment, is sufficient to reject them altogether, forasmuch as nothing is to be admitted in *Philosophy*, which is not clearly and distinctly perceived and known. For what can be more unworthy of a *Philosopher*, than to make those the *Principles* of *Bodily Things*, which he can neither explain by *Definition*, nor demonstrate by *Experience*, nor conceive in his *Mind*?

VI. *Substantial Forms the Refuge of Ignorance.*

Would you take him for a *Philosopher*, who being asked about the *Nature* of *Fire* and *Water*, should tell you that *Fire* is Fire, and *Water*, *Water*? For is it not much the same thing, to say that *Fire* and *Water* are such by their *Substantial Forms*? Or would you think him to be an Interpreter of *Nature*, who being demanded about the *Phases*, or *Appearances* of the *Moon* or *Venus*, and the *Principles* of the *Stars*, would answer, that they proceed from *Forms*, as from their Inward *Principles*? What is this but to call all things by one name, and comprehend them under one and the same *Notion*?

VII. *By admitting Material Forms, it may be question'd whether the Rational Soul be not of the same Nature.*

But you'l say, it is dangerous to reject all *Substantial Forms*, forasmuch as this may be an occasion of doubting, whether there be any *Substantial Form* in *Man*, because we see the same operations in *Brutes*, which are perform'd in us. I answer, that the contrary ought rather to be inferr'd from hence; for by admitting *Bodily Substantial Forms*, and such as are subject to *Death*, it may doubted, whether such *Forms* be not also in us, as they hold to be in *Living Creatures*; whereas by utterly rejecting them, we extol the Dignity of *Souls*, by declaring them alone to be *Substantial Forms*, and that all the rest consist only in the *Motion* of the *Animal Spirits*, *Configuration* of *Parts*, &c. as shall hereafter be declared more at large.

VIII. *The Soul of Man being a Substantial Form, doth not prove that there are other Substantial Forms.*

But the *Soul* of *Man* being a *Substantial Form*, cannot be an *Argument* to prove other *Substantial Forms*; because the *Soul* of Man is a *Spirit*, wholly distinct from *Matter*; whereas other *Forms* are all of them *Material*, and consequently extended: whence we must conclude that they are *Modes* of *Matter*; or if any of them be *Substances*, they must be *Bodies* of a particular Nature, which united to other *Bodies*, constitute *Natural Compounds*.

IX. *Neither did Aristotle ever own them.*

Wherefore the *Schoolmen* certainly differ from *ARISTOTLE*, when they assert the *Forms* of *Natural Beings* to be *Substantial*. He indeed owns the *Form* to be οὐσία, but by this word he doth not mean *Substance*, which belongs to the *General* Nature of *Body*; but *Essence*, which relates to the *Special* Nature of a *Determinate Body*. As for example, the *Form* or shape of *Apollo*, is of the Essence of the *Statue* whereby *Apollo* is represented, but yet is not of the *Substance* of it, as the *Stone* or *Wood* is of which it is made.

X. *An Objection fetch'd from the Distinction of Living Creatures.*

But they will urge further, and say, that *Brute Animals* differ amongst themselves, but they cannot differ by the *Matter*, because that is the same in all *viz.* a thing extended in *Length*, *Breadth*, and *Depth*. Therefore there must be a *Form* by which they may be distinguisht from one another. The Major is proved from *Scripture*, which saith that *God created the Living Creatures according to their kinds, and the Fowl of the Heaven according to their kind.*

XI. *Solution.*

I answer, that we freely grant all this. For the names of *Genus* or *Species* do not always denote *Substantial Differences*, but sometimes only Accidental ones: And this way *Animals* do differ, who are differently disposed and moved; much in the same manner as *Clocks* may be said to be distinguisht, because they have various *Motions* according to the different ways after which they are made. For not only *Substances* differ by *Species* or by *Genus*, but also *Modes* and *Accidents*; for a *Round Figure* doth no less differ specifically from a *Square*, than *Beasts* and *Fowl* do; and yet no body will be so senseless to assert, that those *Figures* differ by *Substantial Forms*; since neither of them include any thing of *Substance*. And so likewise *Beasts* and *Fowl* are said to differ, because *Matter* is variously dispos'd and modified in them.

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XII. *Another Objection drawn from the Difference of Bodies.*

You will say that there are many *Bodies* in the *Universe* which do essentially differ, as *Honey*, and *Wormwood*; and that this Essential Difference cannot proceed from any thing, but from *Substantial Forms*; seeing that the *Accidents* that are in *Honey* and *Wormwood*, as to their *Figure* or Disposition of *Parts*, may be changed, whilst the *Honey* and *Wormwood* still continue the same.

XIII. *Solution of the Difficulty.*

I answer that *Honey* is constituted such as it is by its *Form*, and so essentially differs from *Wormwood*: But that this *Form* is a *Substance* I utterly deny, because the difference of these two, is only from the different configuration, situation, *&c.* of their *Parts*. For tho' it be accidental to *Matter* in general, to have the configuration of the Parts of *Honey* or *Wormwood*; yet is it essential to *Honey* and *VVormwood*, to have such Modifications, to make them such *Bodies*. But of this more hereafter.

CHAP. VIII.

That there are no Qualities, or real Accidents distinct from Substance.

I. *What the Peripateticks Understand by Accidents.*

THE safest way to arrive to the knowledg of those things we enquire after, is to separate them from one another, and by this means distinguish what is obscure, from what is clear in them. But in the Observation of this *Rule*, we must have a care not to encrease the number of *Objects*, or to assign *Existence* to such things, which indeed cannot exist. Which some seem to have done by distinguishing *Qualities* and *Accidents* from *Substances*, and taking them for *Real Entities*, having a distinct Nature from the *Subjects* in which they are found. For they have defined them to be *Things adventitious to Subjects, and that are by Nature distinguisht from them.* And will have their *Essence* to consist not in an *Actual*, but *Aptitudinal inherence*, to shew that *Accidents* may exist separate from their *Subjects*.

II. *They Confound Substance with Accidents.*

But certainly they are in a great mistake, seeing that they confound the notion of an *Accident* with that of *Substance*, whatever they may say to the contrary. For every thing that is *real* involves an Aptitude to exist, and therefore is a *Substance*; seeing by a *Substance* nothing else can be understood, but a Thing, *which stands in need of the Concourse of God only to exist*; which how truly it agrees to an *Accident*, no body will deny, that owns an *Accident* to be something Real, and that it can exist separate from its *Subject*. Moreover, whatsoever is evidently and distinctly known by us, the same is true: But I clearly understand an *Accident* to be a *real thing*, and that it can exist independently of its *Subject*; Therefore an *Accident* is to be called a *Substance*; forasmuch as nothing else is contained in the Conception of a *Substance*. For no stronger Argument can be alledged to prove that two *Things* are the same, than that they have one and the same *Definition*.

III. *If Accidents be Real Entities they may exist by themselves.*

But you will say, that *Accidents* are very weak *Entities*, which stand in need of a *Subject* to support them, and that therefore they do not deserve the name of *Substance*. If this Answer were sufficient, it might as well be said that the *Animal Spirits*, and all insensible *Particles* of *Bodies*, ought to be reckon'd amongst *Accidents*, because they also want a *Subject* to support them, and from whence they have their permanency. It is sufficient to the nature of a *Substance*, that it be an Entity fit or apt to exist. Now forasmuch as *Natural Accidents*, which *ARISTOTLE* defines in his *first Chapter of Prædicaments*, are such *Entities*, and that *Existence* is no where to be found but in those *Entities*, we may well say that they subsist of themselves.

IV. *A Real Accident is a Substance, if the Definition of Substance agrees with it.*

And whereas they say that *Accidents* cannot naturally exist separate from *Matter*, but only by the *Divine Power*; this is nothing to the Purpose; for *Gods Power* doth not destroy the *Nature* of *things*, nor impart any new thing to them. Wherefore, if every thing that can Naturally be separated from its *Subject* be a *Substance*, then that also which by the *Almighty Power* of *God* can be without a *Subject*, may as well deserve the name of a *Substance*. And as to what they say that *Accidents* separated from their *Subjects*, do by a natural propensity require to be restored to them again, neither will this do them any service at all: For as a *Bodily Substantial Form*, which supernaturally can exist separate from its *Subject*, whence it is brought forth, doth not therefore cease to be a *Substance*, because of its natural propensity to be united to *Matter*; so neither doth an *Accident*, that admits the Definition of a *Substance*, cease to have the *Nature* of a *Substance*, tho' by a Natural Propensity it requires to be placed in a *Subject*. Neither will this Exigence ever be able to hinder an *Accident* from being look'd upon as *something Subsisting*, which is sufficient to constitute the *Nature* of a *Substance*.

V. *Real Accidents are useless in Natural Philosophy.*

I cannot imagin why the *Peripateticks* take so much pains to introduce *Accidents* into the *VVorld*, when if there were any such, they could not be perceiv'd by any of our *Senses*: For every Sensation is perform'd by *Contact*; now nothing but the *Superficies* of *Bodies* can be toucht; and that *Surface* which is touched, is not a *Real Accident*, as they falsly imagine, but only the *Mode* of a *Substance*, as consider'd without Profundity. But they will say that *Real Accidents* are to be admitted in order to the explaining of *Sensation*: But neither is there any Necessity for this; since nothing is requir'd to the moving of our *Senses*, besides the variously disposed *Superficies* of *Objects*: For we may easily understand how from the different *Magnitude*, *Figure* and *Motion* of the *Particles* of one *Substance*, divers *local Motions* may be produc'd in another: But we cannot conceive, how by them any such thing should be made as a *Real Accident* is, that hath power to produce local *Motions* in other *Bodies*.

VI. *This is illustrated by the Example of a Watch and Beaten Glass.*

The thing will become more evident by an *Example*: What is it in a *VVatch* that measures the *hours?* Is it any Faculty or Power distinct from the *VVatch* it self? Certainly 'tis nothing besides the *Magnitude* of the *Parts*, the *Fabrick* of the *VVheels*, the Figure of the Spring, and other *Mechanical* affections that produce all those certain and constant *Motions*. Is there any *virtue* superadded to beaten *Glass*, which wounds the *Membrans* of the *Guts*, and makes it *Poison?* Not at all: For the same *Glass* being ground to a very fine Powder may be taken into the *Body* without any danger at all; and the Power in *Beaten Glass* of hurting the *Bowels* proceeds only from the *Firmity* or hardness of its *Parts*,

Parts, and the *Figure* of them, not from any *Occult Quality*, nor from a Faculty distinct from it, proceeding from the *Glass* it self.

VII. *Whatsoever exists is Substance, not Accidenes.* *Real Qualities* therefore, as they call them, are not to be admitted by a *Natural Philosopher*, as being repugnant to sound *Philosophy*, and cannot be understood, even of those, who will needs have them distinct from their *Subjects* as if they were Real Entities. For who could ever conceive a thing to be distinct from another, in which it is, and yet to have no *Existence* but what is dependent upon it? For every thing hath its own proper *Existence*, and whatsoever hath *Existence*, is without our thinking, in the nature of things, and therefore is no *Accident*. It seems a contradiction in *Terms*, to say that a *thing exists*, and yet wholly stands in need of the help of another that it may be; as will be evident to him that minds his own *Thoughts* and *Conceptions*, rather than the *Words* that are tost in the *Schools*.

VIII. *Substance only, is an Entity.* Accordingly *ARISTOTLE* himself *Book 7. Metaph. chap.* 10. expresly asserts that *Substance* alone doth properly deserve the name of *Being*, or *Entity*; and that a *Quality* or *Accident* is not so much an *Entity* or *Being*, as the *Entity of an Entity*, or the *Mode of a Being*. For what is more contrary to Reason, than that that which hath no *Essence* of its own, but borrows its *Existence* from another, to which it is joined, should be reckon'd amongst *Entities*? For as one thing only is said to be sound or Healthy, *viz.* an *Animal*; and all other things are said only comparatively to be so, so far as they have any reference to the nature of an *Animal*; so likewise we are to suppose, that *Substance* alone, according to propriety of *Speech* is an *Entity*, and all other things *Analogically* only, and with reference to that. Wherefore *Quality* in General is thus to be defined: *A Mode of a Substance*, or a certain adaptation of the *Parts* of a *Body* according to *Motion*, *Situation*, *Figure*, *Magnitude* and *Rest*. Forasmuch as from these a *Body* is denominated such like, and the Question *What like a thing is*, may be fitly answer'd.

IX. *Wherein the Nature of Accidents or Modes doth consist.* I am not ignorant that the Asserters of *Real Qualities*, do support their Opinion by *ARISTOTLE*'S Authority; but I can never believe that so Great a *Philosopher* by *Qualities* did understand *Real Accidents*, but that thereby he only meant (as far as can be gather'd from the Examples he alledgeth) that there are divers dispositions of *Parts* in one *Body*, from what there are in another. In which sense I readily admit them, as supposing them only to consist in the *Motion*, *Rest*, *Configuration* and *Situation* of Parts. Thus *Heat*, for Example, is nothing distinct from the *Fire*, but is the very *Substance* of it, or the *Flowing* of its *Particles*, which penetrate and divide the *Wood* or any other *Matter*: So *Figure* is the *Body* it self, with regard to its being bounded by other *Bodies* from any further extension. So likewise *Hunger*, *Thirst*, *Standing*, *and Sitting*, are nothing else but various Affections or Mutations of a *Body*, which we consider as *Modes*, and not as *Real Accidents*, which may be separated from it.

X. *Agility, Soundness of Body and Beauty are not any* And the like we are to conclude concerning *Agility*, *Health*, *Beauty*, &c. For *Agility* is nothing else but a due Proportion of *Spirits*, and strength of the *Nerves*, that procure *Bodily Motion*. *Health* is nothing else, but a convenient Temperament of the *Humors*, and Aptness of the *Members* of the *Body*, in that state which Nature requires. *Beauty* is a fit disposition of *Members* and *Colours*, in a due Proportion to each other. And whosoever pretends *Qualities* to be any thing else, I dare aver that he doth not understand what he asserts; seeing they cannot afford him any notice towards the apprehending of them, or any particular *Idea* concerning them. Nay he cannot so much as know wherein they consist, as shall be made evident hereafter in the case of *Heaviness*, *Motion*, and such like. Except he looks upon them as certain little *Souls*, under the notion of *Spiritual Beings*, which belong to *Bodies*, and perform the same in them, that *our Souls* perform in ours, when they move them. *new things superadded to a Body.*

XI. *Habits are no new things superadded to the Souls* A Modern *Philosopher* explains this point, by the Example of a *Habit*, which is defin'd to be *an Adventitious Quality enabling the Subject to work with ease*. Or, to use his *Words*; The Vigor, Ability and Readiness of a *Natural Faculty*, acquird by repeated *Acts*, enabling one to do that better, more readily and certainly, which he hath several times tryed to do. For by frequent repeated *Actions* (or by an Extraordinary vigor communicated by *Gods Special Grace*) *Habits* are got, which are no new things superadded to our *Soul*, but only *Modes*, as when by frequent *dancing*, the *Feet* acquire a great degree of nimbleness, which Modifies the natural moving faculty.

XII. *The same thing shewed by the Example of a Watch.* We see in a *Watch* that when the *Wheels* are but newly made, and rough, they move more slowly, which afterwards when the Surface of them has been worn and made smooth by long continued *Motion*, move more swiftly: Whence it is that frequently old *Watches* do Anticipate the time, and make shorter *hours*. But who will say that by this smoothing of the *Wheels*, any thing hath been added to them, besides a Modification? since all the change that hath happened to them is, that the *Wheels* are become more smooth and polished, and their Motion swifter than it was before. And the same must be said of our *Mind*, when a *Habit* is added to it, that it can now understand that more readily and easily, which before it naturally did more slowly and difficultly, which plainly is nothing else but a *Modification*, and not any new thing added to our *Understanding*.

XIII. *If we admit Accidents to be Real, we shall not be able to know whether they belong to Matter or Spirit.* Besides, if *Accidents* be Real, we shall never be able to know what *Accidents* belong to a *Body*, and what to a *Spirit*. For if *Accidents* have no Affinity with their *Subjects*, save this only, that they inhere in their *Subjects*, and yet are really distinct from them, we shall not be able to gather from the Perception of an *Accident*, whether the *Substance* in which it is, be *Material* or *Spiritual*; that is, from the *Colour*, *Figure* and *Magnitude* we shall not be able to conclude that it is a *Body* rather than a *Spirit*; neither shall we from *Understanding* and *Willing*, which are the *Modes* of a *Spirit*, be able to conclude, that the *Substance* endued with these *Accidents* is a *Spirit*: No more than from the Nature of a *Body* to which the *Soul* is joined, we can conclude that the *Mind* is a *Body*, or the *Body* a *Mind*.

XIV. *Wherefore Qualities are to be rejected.* Forasmuch therefore as we are ignorant wherein the Nature of a *Quality* doth consist, and can frame no *Idea* of it, it is unbecoming a *Philosopher* to make use of that for the explication of *Natural*

Effects, which can neither be understood, nor defin'd, nor made out by *Experience*. But why then, may some say, are these *Qualities* admitted by the *Peripateticks*? Why, for no other reason but to mask and hide their own Ignorance, and that by fine words they may seem to know that, which indeed they do not. Accordingly if a *Man* ask them why such *Medicaments purge*, they will tell you, because of their *Specifick Quality*. Why doth the *Loadstone* draw *Iron*, or turns it self towards the *Pole*? Because such is its *Occult Quality*. How comes it to pass that the *Bones* of *Mermaids* stop *Bleeding*? Because they are endued with such a *Quality*. O excellent *Philosophers!* who know that the *Loadstone* turns it self to the *Poles*, that *Fire* is *Hot*, that a *Coal* is *Black*, *Honey* sweet, *Gall* Bitter, because of inbred Qualities, but altogether unknown and conceal'd from us.

XV. *What we are to Understand by the Name of Accident.*

What are we to understand then by the word *Accident*, if they be not things distinct from the subject wherein they are? I answer, It is that which happens to an *extended Substance*; and therefore an *Accident* is not any *thing Real*, but a *Mode* depending on the *Substance*. Thus because we conceive the Roundness of a Piece of *Wax*, as having a dependent *Existence* on the *Wax*, we call it a *Mode* or an *Accident*. These *Accidents* have got several names, according to the several ways of our considering them; for as *Substances* are affected and alter'd by them, we call them *Modes*; as from them they are denominated *such like*, they are call'd *Qualities*, and when we only generally consider them as being in any *Substance*, we name them *Attributes*.

XVI. *An Accident or Mode cannot exist without its Subject.*

Whence it is evident that an *Accident* or *Mode* cannot exist without its *Subject*, nor pass from one *Subject* into another: for if that could be, it would follow, that when it was in the first *Substance* it did not absolutely depend on it, which implies a contradiction.

CHAP. IX.

What Intelligible Forms may be attributed to Natural things.

I. *Matter being Passive of it self, must have some Forms by which it may act.*

MAtter being of it self sluggish and idle, and *Substantial Forms*, and *Real Accidents* having been rejected by us, we must take care to furnish it with some *Forms*, that may give to it variety and Distinction. For since *Matter* is a *Passive Principle*, we are to procure it some *Principles* whereby it may be enabled to procure its effects: Which we shall easily meet with, if leaving the *Schoolmen*, we shall betake our selves to the *Mathematicians*, and build our *Philosophy* on their *Principles*.

II. *What are the Forms of an Extended Being.*

For having defin'd a *Body* to be a *Substance extended in Length, Breadth, and Depth*, it remains, that in Imitation of them we consider in it *Magnitude*, that is, a determin'd Measure, which is call'd *Continuous Quantity*, or the number of its parts which is *Discrete Quantity*. Secondly, *Figure*, or the bounding Extremities of the *Matter*. Thirdly, its *Situation*, or diposal amongst other *Bodies*. Fourthly, its *Motion*, or change of *Situation*. Fifthly, its *Rest*, or abode in the same place. So that *Quantity* or *Magnitude*, *Figure*, *Situation*, *Motion* and *Rest* are the *Intelligible Forms* of all *Bodies*, whence their *Rise*, *Nature* or *Essence*, and *Properties* do depend. *A material Form* therefore is nothing else, but *a Complexion of Affections and Modes, that are accommodate to a thing, and to its performing several Actions.* Which *Form* in a sound sense may also be call'd *Substantial*, as being the Form of a *Substance*, that is, of the *Matter*, which it informs and perfects. For *Forms* give to all *Natural Bodies Substance*, and *Essential Difference*, and are the Springs of the operations of every thing, and therefore may well be called *Substantial*: They are contained in these Verses.

Mind, Measure, Rest, and Motion,
With Figure, and Position,
To Matter join'd, the Causes be
Of all what here below we see.

III. *From these the Distinction of things and their Actions do proceed.*

The *variety* of these *Modes* is the Mother of Different things, and their *Conjunction* the *Dispositive Principle* of all *Actions*; which Art the Imitation of *Nature* abundantly teacheth us: For *Artificial things* do no otherwise differ from *Natural*, than that these for the curious contrivance, multiplicity and fitness of *Organs* do exceed the Former, and thereby witness the Transcendent excellence of the *Artificer* that made them.

IV. *The Conditions of true Forms.*

Now that these *Modes* are the *Forms* of *Material things*, will appear more clearly, by assigning those conditions to them, which belong to *Forms*.

The *First* is, that the *Form* be proportionate to the *Matter*, so as to Determine and Define the same, which some call *Actuating*.

The *Second*, That as there is but one and the same *Matter* of all *Bodies*; so likewise there be but one common *Form* to them all, and such as shall affect them all alike.

The *Third*, That as all do own *Matter* to be a thing Extended and Divisible; so the *Form* also may be a thing known to all, and of the *Existence* whereof there can be no doubt.

The *Fourth*, That the nature of it be so clearly defined, that the notion may be as distinct, as is that of the *Matter* which it affects and distinguisheth. For it is the nature of *Principles* to be so clear and evident, that when the mind heedfully considers them, it cannot question their *Truth*.

V. *These Conditions agree to Quantity, Motion, and the rest.*

Now that these I have mention'd are the true Forms of a *Body*, or that they impart a certain *Mode* of *Being* unto the *Matter*, will appear from hence, because all the foresaid conditions of *Forms* agree with them. As to the *First*, it is evident, that *Matter* derives its Distinction from *Quantity*, *Motion*, *Figure*, *Situation* and *Rest*: According as more or fewer of these are found in it. For the Diversity of *Matter* depends on *Motion*, without which there can be no separation of *Parts*. From *Quantity* it derives the *Mode* of its Extension. *Figure* furnisheth it with proportionate *Extremities*. To *Situation* it ows its position amongst other *Bodies*, whether upward or downward, forward or backward. Lastly, by *Rest* it continues in the same place, till by a stronger it be remov'd.

VI. *Magnitude, Motion, &c. are common to all Bodies.*

As to the second condition it appears also that these five *Forms* are common to all *Bodies*, because they affect and diversifie not only *Earthly*, but also *Heavenly Bodies*. For *Heavenly Bodies* have their *Magnitude*, observe their distance and *Situation*,

tion, some of them being moved about their *Axis*, others about their own *Center*, and are bounded by *Figures*, which by the justling of other *Bodies* against them they change and vary.

VII. *Forms exist in Matter.* And according to the Third Condition, these *Forms* are apparent to, and own'd by all, to be in *Natural Things*, as being plainly discernible by us. For who is so dull and stupid as not to discern the *Magnitude*, *Figure* and *Motion* that is in *Bodies*, which are so obvious to his *Senses*? Neither in this do unlearned Men differ from those that are learned, since both own them alike; only the Unlearned considering chiefly their outside, judg them to be *Affections*; whereas the Learned searching more deeply into the Works of *Nature*, find them to consist in the insensible structure of the *Parts*, that by their smallness are not subject to our *Senses*.

VIII. *The Definitions of Forms are Evident.* As to the Fourth Condition, we cannot question but that the Definitions of these *Modes*, are easily deducible from this discourse, and are obvious and evident, not only to our *Senses* and *Reason*, but experience also.

IX. *Tho' these forms are not Substantial, yet are they Essential to some Bodies.* Tho' these *Principles* be only *Modes*, and like *Accidents* are attributed to a *Body* generally taken, yet may they be said to be *Essential* to the *Works* of *Nature*. For it is no contradiction to say that the same thing may be Essential and Accidental in diverse respects: Thus *Wisdom* is Accidental to a *Man*, but *Essential* to a *Wise Man*. *Sense* is the *Property* of an *Animal*, and yet is a *Genus*, with respect to the *Sight*, *Hearing*, *Smelling*, &c. In like manner, tho' *Quantity*, *Figure*, *Motion*, *Situation*, and *Rest* happen to *Matter* in Common, yet this doth not hinder but that they may be Essential to some Portion of it. Thus it is *Accidental* to *Iron* to be terminated by several *Figures*, as to be Round, Square, Sharp, or Blunt; whereas in a *Knife* the *Figure* constitutes its *Form*, and distinguisheth it from other things. For tho' *Iron* may be conceived without this or the other particular *Figure*, yet a *Knife* cannot be a *Knife* except it have such a determinate *Magnitude*, *Figure*, &c. So likewise *Roundness* is accidental to *Wood*, but is Essential to a *Wooden Bowl*. And in a *Clock*, *Magnitude*, *Figure*, *Situation*, the *Motion* of some parts, and the *Rest* of others, are accidental to the *Brass* or *Iron*, because without them they are still *Brass* or *Iron*; but a *Clock* can never have that name, without them.

X. *The Difference of Bodies depends on the Modification of their Parts.* So that the whole *Difference* of *Bodies* doth depend on the Modification of their *Parts*, which are distinguisht according to the variety of their *Magnitude*, *Figure*, &c. as their Identity or sameness consists in the agreement of those *Modes*, and their observing the same Proportion amongst themselves. Wherefore, tho' a *live* Man, and the *Statue of a* Man, be alike in outward appearance, yet cannot they be said to be the same, because besides the *Soul*, which is in a *Living* Man, there is also great diversity of *Parts*, not only as to their number, but in respect of their *Magnitude*, *Figure*, *Connexion*, *Rest* and *Motion*.

XI. *Objection, that the operations of Matter do not depend on these Accidents.* But it will be objected, that these *Modes* cannot produce so many *Effects*, forasmuch as all *Actions* are attributed to the *Subjects* themselves, and not to the *Accidents*, which only operate by vertue of the *Substance*.

I answer, that we acknowled no other *Subject*, but *Matter* furnisht with *Magnitude*, *Figure*, &c. for *Matter* being passive, cannot operate, but by their efficacy. And tho' indeed *Matter* do not derive its *Essence* from these *Modes*, that is, tho' they do not make it *to be a thing*, yet do they cause it *to be such a thing*. Thus that a *Pen* is fit to *write* withal, and a *Key* proper to open a *Lock*, proceeds only from their *Disposition*, *Figure*, *Motion*, &c. for when these are taken away, they are no longer useful. Wherefore, Accidents do not operate, by *Virtue* of their *Substance*, as the Schools will have it; but the *Substance* rather works, by a *Vertue* borrow'd from its *Accidents*. Thus diverse *Weights* are lifted up by a *Beam*, according to the Difference of its *Situation*: Neither would *Iron* cut, if it were not provided with a fit *Figure* and *Magnitude*.

XII. *Answer.*

If you object that these *Principles* are not sufficient to explain all the *Phænomena* of *Nature*, because it cannot be made out by them, how *Warm Water* grows *Cold*, forasmuch as this change cannot proceed from the Different Disposition of the *Water*.

XIII. *How hot water becomes cold.*

This change may very well be explain'd by our *Modes*, supposing *Heat* to be nothing else but *a strong and various Agitation of Particles*: For the *Water* by communicating its *Heat* to the *Air* and the Neighbouring *Bodies*, easily loseth it, except other succeed in the room of that which is lost; for by this means the *Water* is at length depriv'd of its strong agitation, and consequently returns to its former *coldness*.

XIV. *Answer.*

Hence it is evident that the *Powers* of *Bodies*, or their *Faculties* of *Acting*, are nothing else but the *Magnitude*, *Figure*, *Contexture*, &c. of the *Parts* of *Bodies*: For by these all the effects we see in Nature are produced.

XV. *Natural Power consists in the Disposition of Parts*

The *World* therefore is to be consider'd as a wonderful, and most Artificially contriv'd *Machine*, not the parts of it taken severally, but as joined and orderly complicated together. For as in a *Watch* we see many *Motions* performed only by the Contexture of its *Parts* and *Wheels*; in like manner all the Agreement or Likeness and Difference of *Bodies* proceed from their Mechanical *Affections*, viz. *Motion*, *Figure*, *Magnitude*, &c. As for example the Power the *Sun* hath, of attenuating *Water* into *Vapors*, of softning *Wax*, and Hardning of *Clay*, and of producing many other *Effects*, is not deriv'd from any new *Entities* added to it, or Distinct *Qualities*, but from its *Heat* only, which consists in the swift Motion of its Insensible *Parts*, which produceth several *Effects*, according to the different contexture of the *Body* it works upon.

XVI. *The World is to be look'd upon as a Machine.*

It is evident from what hath been said, that there are only two *Principles* of *Natural Things*, viz. *Matter*, which is the same in all *Bodies*, and the *Form* whereby one *Body* differs from another; since it is certain that *Privation*, which the *Peripateticks* add to the two foregoing *Principles*, doth not deserve that name, as being a Non-entity, from which consequently nothing can proceed.

XVII. *There are no more than two Principles of Natural things.*

Hitherto we have consider'd the *Nature* of a *Body* in *General*: We must next enquire into its *Affections*, which are nothing else but *Qualities*, *Attributes* and *Modes*, which agree to *Bodies*, according as they are said to be in this or the other state or condition; such as are those which we are

XVIII. *Of the Affections of Bodies.*

next

next to treat of, *viz. Rarity*, *Density*, *Heaviness*, and *Lightness*, &c. wherewith a Body is variously affected or indued.

CHAP. X.

What Rarefaction is, and how it is performed.

I. *Rarefaction cannot be performed without the entrance of new Matter.*

IT appears from what goes before, that *Extension* is something that is not distinct from *Matter*, and that the one cannot be encreased, but the other must be so likewise. Hence it follows, that in *Rarefaction* and *Condensation* the Constitutive *Quantity* of *Bodies*, is neither encreased nor diminished; but only that in *Rarefaction*, the parts that were before United, are distended, so as some intervals are left between them, which are fill'd up by the entring in of some fluid and moveable *Body*; as is manifest in a *Spunge* swell'd with *VVater*; and that on the contrary in *Condensation*, the separated parts are more closely united, by expulsion of those Bodies that fill'd up the Intervals; as appears in a *Spunge* out of which the *VVater* is squeez'd.

II. *What a loose and, what a close Body is.*

A *Thin* or Loose *Body* is that whose parts are intercepted by *Spaces* fill'd with some *forein Matter*, which afterwards may become a *Close Body* again by expulsion of the more *subtil Matter*, entred from without, by which means the parts come close together. Thus *Boiling VVater* is rarefied in a *Pot* over the *Fire*; for we find that when it begins to *boil*, it swells up into *Bubbles*, which could not be, but by the entrance of some *External Matter*, causing them to swell and be extended: and the same is the case with *VVater*, when it is turned into a *Vapour*.

III. *An Objection rais'd from the Rarefaction of Water.*

You will say, that in this case of a *Vapour* we perceive indeed that *Extension* is encreas'd, but no access of any new *Matter*: Wherefore it is without ground to say that *Rarefaction* is performed by the addition of some other *Body*.

IV. *Answer.*

I answer, that in a *Vapour* there is no more *Extension* or *Quantity* perceived, than there was in the *VVater* before its *Resolution*, because in this change nothing else happens but *a Solution*, *Division* and *Separation* of those *parts*, which before were more closely joined together; For he who at a distance beholds the *Vapours* that rise from *boiling water*, takes them to be a continuous *Body*; but if he take a nearer view of them, he will find them to be nothing else, but a crowd of innumerable small *Particles*, which separate and come between many other *Heterogeneous Bodies*. Wherefore where we find any *Body* dilated, we must conclude that it is by the access of some new *Matter*.

V. *The Bodies which enter the Pores of Bodies are of the same nature with those that strike our Senses.*

But what kind of little *Bodies* are these, which enter the *Pores* of *Rarified Bodies*, and which are expell'd when they become close and hard again?

I answer that they are the same in *Substance* with those *Bodies* which are seen and felt by us; save only that they are more subtil and fluid, and so are fit to penetrate and fill the *Pores* of other *Bodies*. For according to our *Hypotheses*, there are some *Particles* in the *Air* and other *Bodies* so subtil, as to be able to pierce *Gold*, *Diamonds* and the most *Solid Bodies* that are.

VI. *There are Bodies that are not perceptible by the Senses.*

You will say, that we do not find that the *Pores* are dilated in *Rarefaction*, nor that any New *Bodies* enter into them. But to this I answer, that all *Bodies* do not affect our *Senses*, by reason of their extream littleness. We know that a *Vine* in the Spring grows, and becomes extended to a further Length; which Extension could not be, but by an addition of *Bodies*, which dilate and stretch but the *Substance* of the *Vine*. And yet no *Man* ever perceiv'd these *Bodies*. We never saw the *Air*, and yet know that it is extended throughout the whole *World*. Wherefore neither in *Rarefaction* are we to deny *Bodies* to enter into the *Pores*, because we do not see them; but are to judge of what happens in these little *Bodies*, by what we see happens in the greater.

VI. *Why Metals are not rarefied.*

From this Explication of *Rarefaction* it is evident, why *Metals* and other Hard *Bodies* are not rarified without difficulty, but soft *Bodies* very easily, because the parts of them are readily separated and admit other *Bodies*, whereas hard *Bodies*, as *Iron*, &c. are not without great violence dissolved, and by that means hinder other *Bodies* from entring between their parts, wherein the Nature of *Rarefaction* doth consist.

VIII. *It is not necessary that all the Parts of Matter be rarefied.*

You'l say that in *Rarefaction* not only that *Body* is rarefied whose *Pores* are dilated; but also all the subtil *Matter* that enters them, which cannot be without the introduction of other *Bodies*, and these again by the Introduction of others, and so to infinity, which is not to be admitted in *Natural Causes*.

IX. *There are some Particles that do not admit Rarefaction.*

I answer, there is no inconvenience to say that *Bodies* that have *Pores*, become rarefied by the Intromission of others, and these again by the Intromission of other lesser *Bodies*, so we do but admit that there are some *Bodies*, which because they have no *Pores* cannot receive other *Bodies*, and that there are such is not to be doubted, especially by them who hold *Quantity* to be indefinitely extended: For they must acknowledge that the *Parts* of *Matter* may by Division be made so small, that they cannot be further divided but by our Thought.

X. *The Distinction between a Pure and a Rarefied Body.*

You'l say that the more loose or *Rarefied* a Body is, the more *Pure* it is also; as the *Air* is, when it is free from *Clouds* and *Vapours*: But now the *Purer* any *Body* is, the less it admits the mixture of any *External Bodies*; therefore *Rarefaction* is not made by the Introduction of other *Bodies*.

XI. *Answer.*

The *Major* of this Argument is to be deny'd; for *Pure* and *Rarefied* are not one and the same thing: That is *Pure* which is free from any mixture of forein *Matter*: As the *Air* is said to be pure, when it is not obscur'd by *Clouds* or *Exhalations*. But a loose or *Rarified Body* involves the mixture of *External Bodies*, and cannot be understoood without it; as a *Spunge* that is swell'd with the Intromission of *Water*.

XII. *Fire is the ordinary Cause of the Rarefaction of Bodies, whether they be liquid or solid.*

The ordinary Cause of *Rarefaction* is *Fire*; for the subtil *Particles* whereof it consists, being in continual *Motion*, easily enter the *Pores* of other *Bodies*, and dilate them. Hence it comes to pass that *Water*, which hath long boiled over the *Fire*, is more easily congeal'd than *cold Water* newly taken out of a *Well* or *River*, because the most subtil parts of it, which by their *Agitation* and *Motion* hinder'd *Congelation*, are evaporated in the *Boiling*. Neither are *liquors* only, but *Metals*, and other solid *Bodies* somewhat distended by *Heat*. Thus we find that *melted Metals* swell somewhat; and

and that it is common with *thread* dipt in *Brimstone* to cut off *Glasses*, because the Parts of *Glass* being put in *Motion* by *Heat*, require a larger *Room*, which they cannot obtain, without driving away the parts that are continuous to them.

XIII. *The first Corollary from what hath been said before.*

From what hath been said it is evident First, that the *Rarefaction of Air*, *Smoak*, *Vapor* and such like *Bodies*, are nothing else but a separation of the *Terrestrial Particles*, caused by a swift Motion, and the ingress of New *Cælestial matter* into the Spaces left by them. And that the *Condensation* of them, consists in a more intimate union of the said *Particles*, caused by the decrease of Motion or *Heat*, the Intervals whereby they were separated growing lesser, or being taken away, which when ever it happens, the *Body* thereby becomes so close and compact, that it cannot be made closer.

XIV. *The Second Corollary.*

Secondly, we may infer hence that a greater or less *Extension* in *Bodies* that are rarefied and condensed, doth not belong to the *Essence* of a *Body*, but is only a new *Modification* of it, which supposeth a change of *Figure*, and the presence of another *Body* filling the *Pores* of it.

CHAP. XI.

Concerning the Heavinesse and Lightness of Bodies.

I. *What Gravity and Levity is.*

HEavinesse and *Lightness* are the *Qualities* of *Bodies* with respect to their aptness to move upwards and downwards, in the *Sphere* of their *Gravitation*. Where by the name of *Aptness*, we are not to understand any Inclination or Active *Principle*, but only such a disposition of *Parts* which is capable of receiving the force of *Heavinesse* or *Lightness*. And by the *Sphere of Gravitation*, I understand the whole space comprehended between the *Center*, or that which is lookt upon to be the middle, and the uttermost bounds of the cause of depression. Which *Sphere* is not only to be fixed about the *Earth*, but also about the other *Planets*, which being much of the same nature with our *Earth*, it follows, that the union of their Parts proceeds from the same or a like cause to that which keeps the Parts of the *Earth* together.

II. *The opinion of the Peripateticks rejected.*

The *Peripateticks* hold *Heavinesse* and *Lightness* to be innate *Qualities*, proceeding from the Form of *Bodies*, for their Conservation. Accordingly they say that *heavy things* tend downwards, from the foresaid Appetite they have to be preserved in the *Center*, and so be moved by a certain Law of *Nature*, whereby all things are disposed in their proper places, or by a *Motion* impresst by the *Author* of *Nature*. But this *Opinion* is grounded on a false *Hypothesis*. For, *First* it supposeth the *Earth* to be the *Center* of the *World*. *Secondly*, that *Bodies* that are put in *Motion* tend to *Rest*, tho' it be certain that nothing tends to its own destruction. *Thirdly*, that *Heavy Bodies* are preserved in the *Center*. *Fourthly*, that there is an Appetite or desire of this Preservation in *inanimate* things, when it is apparent that a desire is only competible to *living Creatures*.

III. *The opinion of Gassendus rejected.*

Others, amongst whom is *GASSENDUS*, hold that *heavy things* tend downwards by the *Magnetick Virtue* of the *Earth*, which draws them down to it. But this opinion also is built on a false supposition, in that in the *First* place it takes for granted an attractive *Motion*. *Secondly*, in that it supposeth the *Loadstone* to draw *Iron* to it, by its out-flowing *Particles*, which is not so, as will appear hereafter when we come to speak of *Magnetical Operations*. *Thirdly*, the *Magnetick Virtue* is communicated by the *Poles*, and *Lines* parallel to the *Poles*; whence it must follow, that the greatest *Gravitation* would be under the *Poles*, or near them, less in the intermediate places, and least or none at all under the *Æquator*. *Fourthly*, a common *Loadstone* has greater force, than the *Earth* it self, at least with us; whence it must follow, that it would be of greater strength also to the drawing of *Heavy Bodies* downwards; and then a piece of *Iron* cast upwards, would not in a right Line descend to the *Earth*, but towards the *Magnet*.

IV. *Des Cartes his opinion concerning the Heavinesse of Bodies explained.*

The Third opinion is that of *Des Cartes*, who holds that *Heavy Bodies* are driven downwards by the *Cælestial Matter*. For the better understanding of which, we must in a few words explain his *Hypothesis* concerning the *Diurnal Motion* of the *Earth*. He supposeth therefore the *Earth* together with the *Atmosphere* to be pois'd in the midst of a little *Vortex*, which is whirld round from *West* to *East*; whence it necessarily follows by the Rules of *Motion*, that the *Earth* hanging in this *Fluid Body*, must be whirld about with the same motion, by the *Heavenly matter* running against its *Pores*; yet so as that the *Earth* in its *Motion* is not separated from the *Fluid Body* that compasseth it, but as it were *swims* in it. To illustrate this, let us suppose a *Wooden Bowl* in the midst of a *Vessel* with *Water*, if any one make the *Water* whirl round, that is, in the Circumference or near the sides of the *Vessel*, it is notorious that the *Bowl* will turn round likewise, by the *Particles* of *Water*, that dash against the outside of it; and in like manner, is the *Earth* with the *Atmosphere*, *Whirld* about by the *Cælestial circumfluent matter*, not by any motion of its own.

V. *The force of the Cælestial matter drives heavy things downwards.*

And forasmuch as the *Cælestial matter* being very solid and agitated, hath more *agitation* in it, than is required to the *whirling* about of the *Earth*, and is hindred by the *Earth* from continuing its motion in *Right Lines*; what will follow hereupon? It is evident from the *Laws* of *Motion*, that its Motion cannot perish, and therefore will persue its course, what way it can best; that is, it will have a Power of rebounding upwards. Now we know that nothing can move upwards except something move Downwards at the same time; and accordingly that will move downwards, which hath not so strong a force of Agitation, which is the case of all *Earthly Bodies*, except something else should intervene and hinder it.

VI. *An Example taken from a Vessel fill'd with various matter.*

Any one may Experience this by filling some round *Vessel* with small *leaden Bullets*, and amongst them, some pieces of *Wood*, or any other Matter lighter than *Lead*: If this *Vessel* be whirld round swiftly about its *Center*, all the pieces of Wood which have less Agitation will be driven to the Middle by the *Leaden Bullets*, which with greater force recede from the *Center* of their *Motion*.

VII. *Heavy things do not tend*

The same was lately experimentally demonstrated by a *Mathematician* at *Paris*, in a *Vessel* with *Water* agitated, into which if the *Powder* of *Sealing-wax* be cast, the little Particles thereof

downwards of themselves but are driven down.

will be seen driven towards the sides of the *Vessel*, for that by reason of their roughness they are easily carried that way by the strong agitation of the *VVater*. But when that agitation begins to cease, and the *Particles* of the *Water* are more softly moved, this *Dust* or *Powder* is driven to the midst. The *Cause* whereof is this, because as long as any *Agitation* is continued in the *Water*, its parts endeavour to recede from the *Center*, in which recess they force the particles of *VVax* towards the *Center*, and as it were appoint their place to them. Whence it appears, that Bodies are not of themselves carried, but are driven downwards by the Matter that surrounds them.

VIII. *A particular Explication of the Heavinesse of Bodies.*

But to the end that the Action of the *subtil Matter* may be more distinctly perceived, let us imagine all that is included in the *Circle* A B C D to be a Mass consisting of the *Earth*, *VVater and Air*, the Center whereof is E, where the little *Circle* F G H I represents the *Earth*. Then let us imagine this whole *Mass* to be divided into many *Pyramids*, which with their Extremities reach to the Center, one whereof let be A E B. Having supposed this, we shall find first, that tho' all the several *parts*, which make up so many *Pyramids*, strive to withdraw from the *Center* E, yet can they not recede all at once, because there is no empty space about that *Mass* which they constitute, whither they might retire, and the subtil Matter hinders them from moving out of their place. Moreover we shall find that not one of these *Pyramids*, by Example, A E B, can recede whole and entire, enlarging it self in its extremity A B, and driving away from it the adjoyning matter, and making it to come closer to the *Center*: Because the *Pyramids*, which surround the *Pyramid* A E B, do with a like endeavour recede from the same *Center*, and for which they have no less force, than the *Pyramid* A E B. But if we suppose some *Terrestrial Body*, as L. in the *Pyramid* A E B. without any in the Neighbouring *Pyramids*; we shall easily conceive, that it will have less force to recede from the *Center*, than the others, that are about it, by how much the *Body* L hath less force than the subtil *Matter*, whose place it takes up. Whence we must conclude that the Matter of some of the *Pyramids* will recede from the *Center*, and drive the *Body* L nearer to it, after the same manner, as they who hold all Bodies to be Heavy, suppose the *Water* to lift up a piece of *Cork*, and force it to the *Surface* of it.

Figure 11.

IX. *Wherein the Heavinesse of Earthly Bodies doth consist.*

The *Heavinesse* therefore of *Earthly* Bodies consists in this, that the *Globuli* of the *Cœlestial Matter*, being whirld about in their *Vortices*, endeavour continually to recede from their *Centers*, about which they are turn'd; but forasmuch as they cannot exert this their strife and Propension, except in their mounting upwards, they thrust down other *Bodies* into whose place they may succeed: Wherefore they must needs at the same time depress the *Particles* of *Earthly* Bodies that are in the *Air*, as well because of their *Resistance*, as because of the *want* of *Cœlestial matter* in their *Pores*; both which hinder the *Earthly* Particles from having so great a Propension of receding from the *Center* of the *Earth*, as the *Heavenly matter* that every way surrounds them, hath. Wherefore the *Lightness* of the *Cœlestial* Matter is nothing else but the force or strife it hath to recede from the *Earth*; as the *Heavinesse* of the parts of the *Earth* consists in their being such, that this highly *agitated* Matter exerts its power upon them in thrusting of them downwards,

X. *By the name of Heavenly matter we are also to understand the First Element.*

When it is said, that the *Heavinesse* of *Bodies* is caused by the *Heavenly matter*, we do not only understand the *Globuli* of the *Second Element*, but also the Matter of the *First* mixed with it: For this being extreamly agitated, exceeds the Matter of the second *Element* in the force it has to drive *Bodies* downwards. Neither are the *Particles* of the *Air* to be rejected from having any share in this performance, seeing that they accompany them in their Course, and being joyn'd with the *Globuli* of the second *Element*, exert their force, and do not a little conduce to the driving down of *Bodies*.

XI. *The Cause of the Descent of Heavy Bodies is Twofold.*

We may therefore alledge a double *Cause* of the Descent of *Heavy* Bodies; the one *Primary*, *viz.* the *Heavenly* Matter, by its strife upward, not from any innate Appetite, but to continue its Motions according to the *Laws* of Nature. The other *Secundary*, viz. any *Earthly* Body carried upwards, whether it be obsequent to the Motion of the *Heavenly* Matter, *as Air*, *Vapours*, *Exhalations*, and any other lesser *Particles*; or whether it be driven upwards by any other Cause: So *Smoak* agitated by the *Fire*, hath a Power of depressing the *Air*: Thus when any one casts a *Stone* upwards, he at the same time thrusts down as much *Air* in its place; which *Air* because of the *Heavenly* Matter intermix'd with its *Particles*, and its Agitation thereby caused, as likewise its *Elastick force*, will first resist the Motion of the *Stone*, next hinder its *Ascent*, and at last depress or thrust it downwards.

XII. *Whence the various Heavinesse and Lightness of Bodies doth arise,*

You will object, if the *Heavinesse* of *Bodies* depend on both these *Causes*, it will follow that all *Bodies* would be of the same *Weight* or *Heavinesse*, since both the *Heavenly* Matter, and the small *Bodies* carried upwards, do press them after the same manner.

I answer, that the Nature of *Heavinesse* and *Lightness* in *Bodies*, consists herein, that as much *Heavenly* Matter as there is in any *Body*, so much cause of *Lightness* they have, which being substracted, all the rest will come under the notion of *Gravity* or *Heavinesse*. As for Example, *Water* is Heavier than the *Air*, because if you substract the *Æthereal* interspersed Matter from them both, there remains more *Earthly* Matter in the *Water*, than in the *Air*. So that this may be laid down as a General *Rule*, That the more *Heavenly* Matter there is in any *Body*, by so much the *Lighter* it is, that is, the more apt it is to be carried upwards; and the less there is of it, the *Heavier* that *Body* is, that is, the apter to be thrust downward.

XIII *Solid Bodies are more Heavy than soft Bodies.*

Thus *solid* Bodies are more *Heavy* than *soft*, because they have more Matter of their own, and therefore are called *close* Bodies, having less *Pores*, which can only admit the *Subtil* Matter, or the *Globuli* of the second *Element*, such as are *Gold*, *Silver*, *Quicksilver* and *Steel*. But *soft* or less *Solid* Bodies, contain more *Heavenly* Matter; and have greater Pores, and are therefore *Looser* Bodies, such as *Wood*, &c. Wherefore tho' all the *Heavenly* Matter, with all its force strives to recede from the *Center*; yet the more close and compact Bodies have a greater Power to resist, and do more difficulty recede from the *Center* of their Motion:

Motion; whereas *Bodies* of a more looſe Texture, have more of the *Heavenly Matter* than of their own, and a greater Propenſion of receding, and therefore do leſs reſiſt the *Agitation* of the *Heavenly Globuli*, or little round *Bodies*.

XIV. *Whence proceeds the variety of Heavineſs.*

This is the reaſon why the *Water* is placed on or above the *Earth*, and the *Air* above the *Water*; becauſe the parts of the *Earth* being more ſolid than thoſe of the *Water*, and the parts of the *Water*, than thoſe of the *Air*, they are more ſtrongly driven down to the *Earth*, by the *Æthereal Matter*; much after the ſame manner, as *Corn*, that is mixt with *Chaff*, is by the Agitation of a Fan caſt off further, leaving the *Chaff* behind it.

XV. *How it comes to paſs that a Stone towards the end of its motion comes down faſter than at the Beginning.*

It may be objected againſt this, that the *Globuli* of the ſecond *Element*, do ſtrike with a greater force againſt *Bodies*, before they begin to deſcend, than in their falling down; and therefore they ought to thruſt them down more ſwiftly at the Beginning of their *Motion*, than towards the end of it; which notwithſtanding is contrary to experience; for a *Stone* moves ſwifter towards the end of its Motion, than at the Beginning; and therefore the Deſcent of *Earthly Bodies* is not to be aſcribed to the *Subtil matter*.

XVI. *Anſwer.*

I anſwer, that the reaſon of the Difference of the *Stones* Motion is this, becauſe the *Stone* in its Deſcent, retains the Force of the foregoing *Motion*, and beſides receives an encreaſe from the Impulſe of the *Subtil* Matter that follows it; for the *Subtil Matter* is ſwifter than it. Now the cauſe why *Deſcending Bodies* are leſs forceably driven down by the Subtil Matter, towards the *End*, than at the Beginning of their *Motion*, is this, becauſe there is not ſo great a difference of ſwiftneſs between their *Motion*, and that of the *Subtil Matter*.

XVII. *How Bodies can move in the Air ſeeing they are preſt on all ſides by the Fluid Matter.*

But you will ſay, ſeeing that the *Bodies* that are ſurrounded with *Fluid Matter*, are equally preſt upon on all ſides, they are not like to move at all, but will remain hanging in the *Air*. I anſwer, that this indeed would follow, in caſe the *Fluid Body* be ſimply conſider'd as Fluid: But ſince the caſe is otherwiſe here, and that the whole *Fluid Matter*, becauſe of the Reſiſtance of the *Earth*, ſtrives to get free from its Neighbourhood, this is ſufficient to determine the *Motion* of *Groſs Bodies* downwards, as being much more unfit for *Motion*, than the *Heavenly* Matter, and *Fluid Bodies*, in which they are carried, are.

XVIII. *This opinion doth moſt appoſitely explain all the Phænomena of Gravity.*

How Appoſitely this opinion ſolves all the *Phænomena* of *Heavineſs* will appear from the following particulars.

Firſt, This force will exert it ſelf every where throughout the *Earth*, becauſe the Celeſtial *Matter* will find reſiſtance every where, that is, it will be determined upwards as well towards the Poles, as about the *Æquator* and Lines *Parallel* to it.

Secondly, All things fall down perpendicularly to the *Horizon*; becauſe the *Cæleſtial Matter* hitting againſt the *Earthly Particles*, will rebound back with infinite variety, becauſe of their different meeting, Figure and Situation of their Parts, that is *on every ſide* equally, at leaſt to *Senſe*; and conſequently will make all thoſe things Fluid, which are fit to follow its motion; and whatſoever is impulſt by the *Fluid Maſs*, will fall perpendicularly, becauſe it is with equal force preſt on all ſides.

Thirdly, The *Sphere* of Gravity becomes terminated, where this force of receding, becauſe of the too great diſtance, is not ſtrong enough.

Fourthly, Here we find the reaſon, why every *Planet* hath its *Sphere* of Gravity, becauſe nothing elſe is required to this, but its ſwimming in the midſt of *Fluid Matter*.

XIX. *Heavineſs is either abſolute or Reſpective.*

From all that hath been ſaid it is obvious, that *Heavineſs* is nothing elſe, but the ſtrife or effort wherewith a *Body* is puſht towards the *Axis* of the *Earth* by other *Bodies*, which ſtrive to recede from it. That *Abſolute Heavineſs* is that by which every *Body* is puſht downwards by a Column of the ſecond *Element* equal to its own; and that *Reſpective Heavineſs* is that which belongs to a *Body*, only with reſpect to other *Bodies*.

CHAP. XII.

Concerning Place.

I. *What Place is.*

HAving examin'd the *Rarefaction* and *Condenſation* of *Bodies*, and inquir'd into the Reaſon of their *Heavineſs* and *Lightneſs*, it remains now to conſider why *Bodies* are ſaid to be in a place, and what order they keep amongſt themſelves. Now *Place* is nothing elſe, but *a reſpect of the Situation of a Body, which it hath amongſt other Bodies, to which it is either near or far from.* So that when we ſay that a *Body* is in a place, we only intimate thereby that it hath ſuch a *Magnitude*, *Figure* and *Situation* amongſt other *Bodies*, with reſpect to its nearneſs to them or remoteneſs from them.

II. *What Place is according to the opinion of the Common People.*

True it is, that the Common People diſtinguiſh *Place* from a *Body*, and ſuppoſe *Place* to be the *Space* that receives a *Body*, and contains it. For they perſuade themſelves that *Place* is a kind of *Space* which Exiſts before the entrance of the *Body*, and remains after it is withdrawn. But this conceit ariſeth from a Popular error, by which they imagine that there were ſome extended empty *Spaces*, before that there were any *Bodies* in Nature, and which were afterwards to receive them. As ſome *Philoſophers* now ſince the *Creation* of the *World* fancy that there is a kind of empty *Space* beyond the *Bounds* of the *World*, which they call *Imaginary Space*, becauſe it hath only *Extenſion*, without containing any *Body* at all.

III. *Space is the ſame with a Body.*

But theſe *Philoſophers* ſpeak very improperly, ſince whatſoever is extended *in Length Breadth and Depth*, and wherein *Parts* can be aſſigned, by the intervals whereof *Bodies* may be ſaid to be near or far off from one another, cannot be ſaid to be a thing Imaginary, but a true and real *Body*. For the *Nature* of a *Body* conſiſts in *Extenſion*, and the *Idea* of *Extenſion* is the ſame with the *Idea* of a *Body*. Seeing therefore the *Imaginary Space*, as they call it, hath *Length*, *Breadth* and *Depth*, it muſt needs be a *Body*. Whence it is apparent how improperly they ſpeak, who tell us that *Bodily things* are in a *Space*; for ſince every *Space*, becauſe of its *Extenſion*, is diſtinguiſht from the *Dimenſions* of the *Body*, that is in the *Space*, and that Penetration of Dimenſions is impoſſible, ſhould we ſuppoſe a Space to receive a *Body*, this would be a *Penetration* of *Dimenſions*. Now *Bodies* are therefore

fore said to be *impenetrable*, because they have their peculiar *Dimensions* which exclude any other, and do not suffer them to be contain'd in the same place; and since a Space is measur'd with the same *Dimension* as a *Body*, therefore a *Body* cannot be said to be in a *Space*.

IV. *In what Sense a Body is said to be in a place.*

But you'l say, how then is a *Body* said to be in a *Place*, if a *Place* be extended as well as a *Body*, and that one of them exclude the other? I answer that a *Body* is said to be in a *Place* by the *Situation*, *Magnitude* and *Figure* it hath amongst other *Bodies*; so that we must not conceive any thing as extended, but only the *Body* that is in the *Place*, and all the *Space* or Expansion that is conceiv'd to be there, must be attributed to the *Body* only. For to speak properly, *Place* or *Space* is nothing else, than something that is extended *in Length Breadth and Depth*, which is the same with *Matter*; neither can it be distinct from it, but by our way of conceiving. Wherefore when a *Body* is said to take up a *little* or *great place*, the meaning of it is only this, that such a *Body* hath a greater or less Extension amongst the *Bodies* that surround it. This gave occasion to *St. AUSTIN* to say *Epist. 52. ad Dard. Take away Spaces from Bodies, and they will be no where, and being no where they will not be at all.*

V. *Space is not Really distinct from a Body.*

Wherefore there is no Real Difference between a *Space* and a *Body*, but only according to our way of *Thinking*, viz. because we consider the Extension of *Space* as *Common* and *General*, but the Extension of a *Body* in a *Space*, as *Individual* and *Singular*. As for Example, when a *Stone* is taken up out of its *place*, we suppose its extension to be removed also, because we look upon it as singular and inseparable from it; but yet we conceive that the Extension of the *place* in which the *Stone* was, still continues, and is the same, tho' the *Stones Place* be now taken up by another *Body*, viz. *Wood*, *Air*, *&c.* Because this Extension is consider'd in General, and suppos'd to be one and the same, whether of the *Stone*, *Wood*, *Air*, or any other *Body*, provided it be of the same *Bigness*, and have the same Situation amongst those *Bodies* that determine and bound that Space. Wherefore it is evident that the *Inward Place*, which is taken up by any *Body*, doth not differ from the *Body* it self, no more than the nature of the *Genus* or *Species* differ from the *Individual*. And tho' a *Body* may be said to change its *Place*, this is not to be understood of the *Inward*, but only of the outward *Place*, that is, of the Superficies of those *Bodies* that surround it, to the different parts whereof, it may be diversly apply'd.

VI. *Place is twofold, Inward and Outward.*

This will be more evident by distinguishing *Place* into Inward and Outward; *Inward Place* is nothing else but the *Matter* it self extended in *Length Breadth* and *Depth*, or the *Body* it self: *Outward Place* is the *Superficies* of the *Body*, which immediately surrounds the thing Placed. And this *Place* is neither a *Body*, nor any thing of a *Body*, but only a *Mode* of it, or the limit wherein the *Body* is contained. For by the name of *Superficies*, no part of the *Ambient Body* is understood, but only the Boundary or limit, that intervenes between the *Ambient Body* and the *Body surrounded*, which is only a *Mode*. Or we understand thereby a *Superficies* in common, which is no more the part of one *Body* than of another, only is suppos'd always to be the same, because it retains the same *Magnitude* and *Figure*. For tho' every *Ambient Body* together with its *Superficies* be changed, yet is not the thing it surrounds therefore supposed to change its *Place*, provided it keep the same Situation amongst other *Bodies*, which are consider'd as *immoveable*. Thus we do not say that a *Tower* changeth its *Place*, when the Ambient Air leaves it, because we suppose that still other *Air* comes in the room of it, and accordingly the Superficies is neither a Part of the *Body* containing, nor of that contained, but only an intermediate term or limit, which indeed is nothing else but a *Mode*.

VII. *A Body in the Imaginary Space, is neither here nor there.*

Moreover it is evident, that, if there were any such *Imaginary Spaces*, the *Bodies* contained in them could not be said to be in a *Place*, forasmuch as in them there is no *outward Place*, neither can any parts be assigned to them; and therefore a *Body* cannot be said to be *here* or *there* in them, notwithstanding that it really takes up a *Place*. But a *Body* being consider'd as something consisting of *Parts*, and consequently contiguous to other *Parts* of *Bodies*, according to this *Notion* there can be no *Body*, which hath not a determin'd *Place*, with respect to its *nearness* or contiguity to some other *Body*, by which its *External Place* is designed.

VIII. *The Difference between External Place, and Space.*

The difference therefore between *External Place* and *Space* is only this, that *Place* more expressly denotes the *Situation* of a *Body*, than its *Magnitude* or *Figure*; whereas *Space* refers rather to these two latter. For we often say that a *thing* comes into the place of another, tho' it be not exactly of the same *Bigness* or *Figure*; but at the same time deny it to take up the same *Space*: And so whenever the Situation is changed, we see the *Place* is changed, tho' the same *Bigness* and *Figure* do remain. And when we say that a *Thing* is in a *Place*, we mean nothing more than that it hath such a *Situation* amongst other *Bodies*; and when we say that it fills such a *Space*, we understand thereby its being of such a determinate *Figure* and *Magnitude*. All which will be further cleared by the following *Rules*.

IX. *The First Rule.*

When a *Place* is said to be equal to the *thing placed*, this is either understood of the *Inward Place*, and then it is the same, as to say, that a *Body* is of such *Dimensions*, or equal to it self; or else of the *Outward Place*, and then it imports, that the bounds of the Ambient, do exactly answer to the *Superficies* of the *Body* surrounded or contained, but not as if they had equal *Dimensions*: in like manner as the *Rule* is said to agree with the thing ruled, tho' it do not agree with it every way, as to its threefold *Dimension*.

X. *Second Rule.*

Two *Bodies* cannot be in *the same place at once*, that is, they cannot at the same time have the same respect of distance to the same *Bodies*; for if so, they must penetrate each other, and there would be a *Multiplication* of *Extension*, without supposing any new *Parts*, which is contradictory to the Notion of a *Body*.

XI. *Third Rule.*

One *Body* cannot be in two *Places* at the same time, that is, it cannot be placed between these and other contiguous *Bodies* at the same time, because a Plurality of *Places* infers a Plurality of *Bodies*; for *Place* is only the *Mode* of a *Body*: Or thus: *Space* is not distinct from a *Body*, therefore the *Body* that is in diverse *Spaces*, is both another and the same thing at the same time.

Fourthly,

XII. *The Fourth Rule.* Fourthly, a *Body* is said to change its *Place* when it changeth its respect to other *Bodies*; and forasmuch as we can have regard to different *Bodies*, the same thing may be said to change its *Place*, and not to change it, under a different regard; tho' most properly a thing is said to change its *place*, with respect to those Contiguous *Bodies*, that are considered as immoveable.

XIII. *How the Inward Place is distinguish'd from the Outward.* Whence it appears that the *Inward Place* of a *Body*, or the Space it takes up, consists in the *Body* it self, consider'd as bounded by other *Bodies*, which immediately touch it; and that the *Outward Place* consists in the first *Surface* of the *Bodies* that surround another *Body*.

CHAP. XIII.

The supposing of a Vacuum in Nature, implies a Contradiction.

I. *What a Vacuum is according to the Sense of the Common People.* IT cannot be denied but that the common way of *Speech* doth frequently differ from *Truth*, and that they are lyable to mistake, who mind *words* rather than their own *Notions*; as they seem to do, who by the word *Vacuum*, understand the absence of some *Body*, which ought to be in such a *Place*. As when they say, that a *Vessel* is *Empty*, which is not fill'd with *Water*, *Wine*, or the like; or a *Purse* is *empty*, in which there is no *Mony*, and *a Space* empty in which there is no sensible *Body*.

II. *What a Vacuum is according to the sense of Philosophers.* But learned *Men* allow nothing to be empty, but what is devoid of any *Body* whatsoever; and therefore they commonly define it a *Place void of Body, yet fit to be filled.* This *Vacuum* is twofold, *Disseminate* or *Coacervate*.

III. *What a Disseminate Vacuum is.* A *Disseminate* or interspers'd *Vacuum* they call small *Spaces*, which are suppos'd interspers'd between *Material Things*.

IV. *What a Coacervate Vacuum is.* A *Coacervate Vacuum*, is a sensible *Space* void of *Body*, such as they suppose to be in a Pipe of *Glass* after the removal of the *Quicksilver* in the *Torricellian* Experiment.

V. *That neither the one, or the other of these Vacuums can be admitted, appears First from the Nature of a Body.* That neither of these *Vacuities* can be found in the *Universe*, may be prov'd by many *Arguments*. First because every *Space* imports *Extension*, which is of the Essence of a *Body*; for it implies a Contradiction that *nothing* should have an *Extension*, and therefore there cannot be any *Space*, in which there is not a Corporeal *Substance*. For as we suppose a *Body* to be there, where we find *Extension*; so for the same Reason we must conclude, that a *Body* must be in a *Space*, because we clearly conceive *Dimensions* in it: So that it is not more impossible to conceive a *Mountain* with out a *Vally*, than to conceive *Space* without *Matter*.

VI. *Secondly from the Definition of a Vacuity.* Secondly, a *Vacuum* is defined to be *A place devoid of Body*: Now this also implies a contradiction, supposing the notion we have already given of *place* to be clear and distinct; for where there is no *Body*, neither can there be any *Mode* of a *Body*; yea, the very empty *Space* it self, will be no less in a *Place*, than any *Body* whatsoever, as is evident to him that considers it well: And what can be more unworthy for a *Philosopher*, than to accommodate this *Idea* to a *Non-Entity*, which altogether agrees to a *Real Being*?

VII. *What would follow, if whatsoever is in a Space should be taken out of it by God.* You'l say that *God* can take away all the *Substance*, that is contain'd between the *Walls* of a *Chamber*, and keep any other *Body* from entring it; upon which supposition a *Vacuum* must follow.

VIII. *First Answer.* I answer in the *First Place*, that this or the other *Body* may be taken out of a *Chamber* or any *Vessel*; but it is impossible that they should be without any *Body at all*. For where there is no *Body*, there is no *Extension*, where there is no *Extension*, there is no *hollowness*, capacity or interval, and without these there can be no *Vessel* or *Chamber*.

IX. *Second Answer.* *Secondly* I say, that supposing all intermediate *Bodies* to be taken away, the *Chamber VValls* would touch one another, because nothing would be between them; for we cannot conceive one thing to be distant from another, without some Middle thing to separate them; because *distance* is a *Mode* of *Extension*, and therefore follows a *Bodily Substance*, without which it can neither be, nor be conceived.

X. *To conceive a space without Extension, implies a Contradiction.* But you will say, that the *Body* which is conceiv'd to be in the *Chamber* or *Vessel*, is something different from the sides that surround it, and therefore the one may be separated from the other by the *Divine Power*, forasmuch as we clearly and distinctly understand the one, not to be the other.

I dare not say that any thing is impossible to *God*, or that he cannot make a *Mountain* without a *Valley*: But this only I assert, that *God* hath made my *Mind* such, that I cannot conceive how a *Mountain* should subsist without a *Valley*; or how *Five* and *One* should not make *Six*. And the same may be applied to that *Space* which is imagin'd to be between the *Sides* of a *Chamber* or *Vessel*, because the same cannot be conceived without extension. And since *nothing can have no Properties*, that *Space* cannot be said to be a *Vacuum* that is void of all *Matter*. Or if that should be, the *sides* of the *Chamber* or *Vessel*, must be suppos'd to touch each other. For if God should annihilate all the *Air* that is in a *Chamber*, there would be no *Space* left between the *VValls*; for if any *Space* be left, there must be *Magnitude* also; and if *Magnitude*, then *Quantity*; and if *Quantity*, *Matter*, and consequently a *Body*, because *Space*, *Magnitude*, *Quantity*, *Matter* and a *Body* are one and the same thing.

XI. *If Bodies be taken away, all distance is taken away likewise.* For what can be imagin'd more absurd than to assert that the distance of *Bodies* is owing to an Imaginary *Space*, or *nothing*, seeing that when the intermediate *Body* is taken away, all distance must of necessity be taken away likewise? Who will say that *nothing* can be *measur'd*, when it is evident, that not only *Extension*, but any other Propriety whatsoever, must be remov'd from *Nothing*? For if I may say that a *Space* (which is nothing) is of such a length, I see no reason why I may not as well ascribe other *Properties* to it, such as *Hardness*, *Softness*, &c. It remains therefore that *Nothing* cannot make a Distance between *Bodies*. For suppose we a *Square Vessel* A B C D, and the *Hollow* of it to be empty, I say that the same cannot be measur'd: For tho' if it be enquir'd by what thing the sides A B, D C are distinct from one another, it may be readily answer'd by the *Straight Lines* A D, B C. Yet I cannot return the same answer to him that enquires the distance between the opposite *Angles* D B: for if I should say they are kept at a distance by the *Straight Line* D B, how can this be true, seeing nothing at all is in the *Vessel*, and therefore no *Length* or *Measure* can be apprehended in it?

Figure 3.

XII. *There is a necessity for the Connexion of Bodies.* This Conclusion may be confirmed from the necessity there is of a Connexion of all the *Bodies* that do constitute the *Universe*, and that they be so

joyned together as not to be separable from each other. Which yet is not so to be understood, as as if there were such a Connexion, between this *Chamber* suppose, and the particular *Air* that is in it, that they cannot be separated from each other; for we see that this *Air* is driven out by the *Wind*, and that other comes into its *place*; but only thus much, that there is a necessary *Connexion* between this *Chamber*, and *Quantity* in General, forasmuch as there can be no *Distance* or *Interval*, but must be fill'd with some *Body* or other.

XIII. *Supposing a Vacuity, two Round Bodies would totally touch one another.*

The same may be farther prov'd from the Absurdity which would otherwise follow; because supposing a *Vacuum*, *Round Bodies* would touch one another after the same manner as *Flat Bodies* do, that is, totally. For those *Bodies* are said totally to touch each other, between which there is no intervening *Medium*; but betwixt two *Round* Bodies in a Vacuity there can be no Medium assign'd; therefore they touch with their entire *Superficies*. It is not sufficient for the solving of this, to say, that a Possible *Substance* mediates between them, because a Possible *Substance* cannot be an *Actual Medium* dividing and separating *Bodies*: For otherwise nothing in the *World* could be said to be *united*; since between the Parts of *Bodies* that are united there is some Possible Medium that may divide them.

XIV. *An Objection, that Distance is nothing else, but a negation of contact.*

If you say that *Distance* is no Real *Thing*, because two *Bodies* may be conceiv'd to be *distant*, only by the Negation of their contact; and that it is not necessary for any thing to intervene between *Bodies* to make them distant from each other.

XV. *The Objection answer'd, and distance prov'd to be Extension.*

I answer, seeing Distance is a *Relation*, which must be between more than one, it belongs to *Opposition* or *Distinction*, the *Essence* whereof consists herein, that one thing is not the other. But forasmuch as there is no *Real Distinction*, which hath not its *Foundation*, because *nothing can have no affections*, therefore the *Foundation* must consist in something that is different from the things between which there is a *Distance*, which since it cannot be *Spiritual* (for then it would be void of Extension) it must be *Material* or *Corporeal*. For it would be a very improper Answer to the Question, why *London* is at a distance from *Paris*, to say, Because they do not touch one another; for this would be the same thing as to say, that *London* and *Paris* are at a distance, because they are not near one another, which is to explain an unknown thing, by another thing equally unknown. We conclude therefore, that *Distance*, besides the *Negation* of *Contact* doth necessarily include *Extension*, by means whereof remote *Bodies* are said to be distant from one another.

XVI. *Nature doth not abhor a Vacuum.*

Hence it appears how falsely the *Schools* assert, that *the motion towards mutual Contact*, is prevalent above all others, as being ordained for the Conservation of the *Universe*, by the avoiding of a *Vacuum in Nature*: For how can *Nature* be said to avoid a *Vacuum*, seeing that an *Empty Space* implies a contradiction? For those things are us'd to be forbid by the *Laws*, which may be done, and not such whose being implies a contradiction.

XVII. *Water condensed in a close stopt Vessel, doth not leave a Vacuity.*

All other *Arguments* made against this opinion are of no force at all against us, who assert the *Extension* of *Space*, not to differ from the *Extension* of a *Body*, forasmuch as it includes *Length*, *Breadth* and *Depth*. What they object of a *Vessel* fill'd with hot *Water*, which tho' it be close *stopt*, yet the *Water* that is in it, is reduc'd to a less *Space*, and consequently must leave a *Vacuum*, is of no Moment at all, because the Space which they imagine to be void, is fill'd with the subtil Matter penetrating the Pores of the *Vessel*; for it is a meer vulgar Errour, to believe those things to be Empty, which we do not see to be fill'd with *Bodies*.

XVIII. *A Body is no less fill'd with one Body than with another.*

It is evident from what hath been said, that a *Vessel* doth not contain more Matter when it is fill'd with *Gold*, than when it is fill'd with *Air*, forasmuch as there is as much extension in the *Air* as in the *Gold*. A *Vessel* indeed may contain more *Gold*, than it can of *Pumice Stone*, because in this latter there are many *Pores* which are fill'd by the *Air*, and not with its own *Substance*.

CHAP. XIV.

Of the Vulgar and Philosophical Definition of Motion.

I. *Local motion only is to be admitted of in Philosophy.*

BY the name of *Motion* we only understand that which is *Local*, as being the only *Motion* that is found in *Nature*, and to which all the rest are to be referr'd. For tho' *ARISTOTLE Lib. 8. Physic. cap. 7.* reckons up three kinds of *Motion*, viz. *Motion in Magnitude*, *in Affection*, *and in Place*; *yet he asserts that the latter of these must needs be the first of all Motions*, and concludes, that *Generation* and *Corruption*, *Accretion* and *Diminution*, and last of all, *Alteration*, cannot be without *Local Motion*. For what else is the Motion of *Generation* and *Corruption*, but *Local Motion*, whereby the sensible and insensible parts, are fitly, or unfitly joyned together, according to the *Essential Constitution* of *Bodies*? So likewise in *Accretion* and *Diminution* there is a *Local Motion*, whereby several parts are united to the *Body* growing; or whereby those that have been joyned with it, are now separated from it. And as to *Alteration*, we find for Example, that *Calefaction* or *Heating* is perform'd by *Local Motion*, it being nothing else but the swift agitation of the *parts* of some *Body*; as in *Refrigeration* or *cooling*, the said parts are more slowly moved, or have no *Motion* at all. Tho' indeed if we would speak strictly, all the other *Species* of *Motion* that are commonly reckon'd up, are rather changes made by *Motion*, than *Motions*.

II. *All other Motions are but the Differences of Local Motion.*

Wherefore seeing that all these kinds of *Motion*, are only certain *differences* of *Local Motion*, denominated from their various effects of *Generating*, *Corrupting*, *Encreasing*, *Diminishing* and *Altering*, we should multiply *Entities* in vain by going about to establish any other sorts of *Motion*, besides *this*.

III. *Motion examin'd according to the sense of the Common People.*

But that we may the more clearly discover the nature of *Motion*, we will first enquire what is understood by this *Word*, according to the vulgar acception of it, and then come to explain the true and *Philosophical Notion* of it.

IV. *What the Common People understand by Motion.*

The Common *People* by *Motion*, understand the *Action whereby some Body is remov'd from one place to another.* This is that which they do mean by *Local Motion*. And therefore they suppose that a *Body* may at the same time be moved, and not be moved, as a *Master* of a *Ship*, who is said to be moved, if the Shoar be consider'd as immoveable; and not to be moved, with relation to the *Stern* of the

Ship

Ship where he sits. *Secondly*, by this action the Common *People* imagine, that a greater force is required to produce *Motion* than *Rest*. Which *Judgment* they make, because they find that the *Command* of their *Will* is required to the moving of their own *Bodies*, whereas they *Rest* by their own *Weight*, without standing in need of any other thing to stop them. But they may be easily convinc'd of their error by putting them in *Mind*, that very often there is as much action required to stop the *Motion* of *Bodies*, as there is to move them: For there needs as much force to stop a *Stone* that is tumbling down from a *Mountain*, as to tumble down a *Stone*, that lies still on the top of it.

V. *Five things to be consider'd in Motion.* There are five things to be consider'd in every *Motion*; the *mover*, the *moved*, the *Term from which*, and the *Term to which*, and *Succession*. The *mover* is that which doth move; the *moved*, is the *Body* that is *moved* by the Action of the *mover*; the *Term from which*, is the Neighbourhood of those *Bodies* which it quits; and *the Term to which*, is the Neighbourhood of those *Bodies* to which the *Body* comes; and *Succession* is that progress whereby the thing moved is continually in a different manner apply'd to the various *Parts* of *Ambient Bodies*.

VI. *Wherein Motion properly doth consist.* Now to the end that this *Progress* or *Succession* may be the better understood, we are to observe, that *Motion* may be consider'd three manner of ways: *First*, as it proceeds from the *mover*, as by example, from a *Man* who throws a *Stone*, and so in the *mover* it is call'd an *Action*. *Secondly*, as it is receiv'd in the thing *moved*, at the first moment of its impulse, whilst it is yet joyned to the *mover*, Ex. Gr. in the *Stone*, which a *Man* casts, and so it is a *Passion*. *Thirdly*, forasmuch as it is in the *Body* moved, separated from the *mover*, as in *a Stone*, when it is carried through the *Air*, and so it is a certain *Mode* or state opposit to *Rest*; and in this last Sense *Motion* is here taken: And accordingly *Motion* is defin'd to be, *the Translation of a Definite Body from the Neighbourhood of Bodies that immediately touch it, to the Neighbourhood of other Bodies*. Or it is the successive application of one *Body*, to the *Parts* of *Bodies* immediately touching it.

VII. *Why Motion is called Translation.* It is call'd a Translation in the *first* place to shew that *Motion* is not a thing subsisting, but only a Mode of *Substance*: For a *Body* is otherwise when it is moved than when it rests. *Secondly*, to distinguish it from the *Action* that translates it, or the Cause of its Motion: For that *Rule* of *Logick* is sufficiently known, that *the cause cannot be the Genus*: For we do not say that a *sound* is the motion of the *Air*, but a *Quality* arising from the *Motion* of the *Air*. And in like manner we must not say that *Motion* is an *Action*, but a *Translation* caused by some *Action* or force, which will more clearly appear, when we shall shew hereafter, that the Moving force is not a *Mode* of the *Matter*, but the *Action* of *God*.

VIII. *And from the Neighbourhood of Bodies that touch it.* It is said to be *the Translation of one Body out of the Neighbourhood of Bodies Immediately touching it*, &c. not from one place to another, because by the word *Place* nothing of certainty is signified, forasmuch as with respect to diverse things, the same thing may be said to change its *Place*, and not to change it. So he that sits in a *Ship*, changes his *Place* with regard to the *Shoar*, which he leaves, and does not change it regard being had to *the parts of the Ship*. Now by defining *Motion* to be a *Translation from the Neighbourhood of contiguous Bodies*, we denote that the *Body* is moved by its own proper *Motion*: So that tho' many common *Motions*, may be at the same time attributed to the same *Body*, yet one of these only is its *Proper Motion*, *viz.* that whereby it is separated by *Bodies* contiguous to it. As he that sits in a *Ship*, tho' he participate of the various *Agitation* of the *Ship*, yet is he not moved with any proper *Motion* of his own, because he abides fix't and unmov'd as to the contiguous *Bodies* that are about him.

IX. *What is meant by one Body in the Definition.* By *one Body* is understood all that which is transferred; tho' it may consist of many parts, which have other *Motions*. Because these Motions are not really distinct; it being a difficult thing to understand so many *Motions* together: As for Example, when the *Body* of an *Animal* is moved, his *Tongue*, *Hands*, *Blood*, and *Spirits* are moved also; all which *Parts* have their particular *Motions*, besides the common *Motion* of the whole *Body*, which they partake of.

X. *How Bodies are moved, since there is no Vacuum into which they may be received.* But the Difficulty is since there is no *Vacuum* in *Nature*, and that all the *Bodies* of the *Universe*, have proportionate places which they fill up, how can *Bodies* be moved when there is no empty space to admit them?

XI. *Answer.* I answer that *local motion* may very well be performed notwithstanding the absolute Plenitude of the *Universe*, not by means of any *Compression* and *Dilatation* of the Fire (as the *Peripateticks* tell us) but by a circular yielding of *Bodies*; so that when a *Body* is moved, it thrusts the next *Body* in its way out of the *Space*, which it enters into, and that again thrusts out another, and so to the last; which enters upon the place which the first *Body* has left, at the same instance that it leaves it. This we see in a round *Pipe* fill'd with *Bullets*, that the first of them cannot be moved, except the last by the impulse of the intermediate ones do succeed into its *Place*. Thus our *Philosophy* rejects all *similiar*, *Magnetical* and *Electrical Attraction*, and every motion which is not performed by the impulse of *Bodies*, according to the *Rules* hereafter to be mentioned.

XII. *How it comes to pass that liquor doth not run out of a Tasting Pipe.* So that whenever this *Circular Motion* of *Bodies* is hindred, there can be no Motion at all; as may be seen in a *Tasting Pipe* used by *Wine Coopers*, represented by A B C, the upper Orifice A, being shut, and the inferior C, open. For tho' the *liquor* that is contain'd in it be much heavier than the *Air*, that is without; yet because the *Air* that is prest by the *liquor* ready to run out of the under *Orifice* C, cannot recede, because the upper *Orifice* A, is stopt from receiving the *Air* that should succeed instead of the *liquor* running out of C, therefore the *liquor* continues in the *Pipe* as finding no place to receive it, because the circular *Motion* of *Bodies* is hindred, by the stopping of the upper *Orifice* of the said *Pipe*. Figure 4.

XIII. *A Body is more swiftly moved through a narrow Passage.* Thus may we see that the *Motion* of *Bodies* may very well be explained without *penetration* of *Dimensions*. And if it chance to happen, that the *Circle* through which the *Body* is to pass be unequal, that is narrower in one part than another, it must necessarily follow that the *Body* must be more swiftly moved where its passage is narrow, and so compensate the straitness of the place, by the celerity

rity of its *Motion*. For it is one of the *Laws* of *motion*, *that when any liquor passeth from a large place to a straiter, the swiftness of its motion encreaseth proportionably to the decrease of the wideness of its passage.* This may be shewed by many examples: Thus *Winds* are more vehement in a narrow *passage*, than in a wide *Street*; a *Bellows*, tho' but leisurely compress't, sends out the *Air* through the *Nuzzle* with great swiftness and force; and *Waters* otherwise gliding gently, when they pass through *Sluces* run violently; and this because it is necessary that the whole *Circle* of *Bodies* should move all at once.

XIV. *Plato"s way of explaining how all motion is made by a Circle.*

This opinion is thus explain'd by *PLATO* in his *Timæus*: *Forasmuch*, saith he, *as there is no Vacuum any where, into which any thing that is moved can enter; and yet our breath continually goes out from us, it is apparent to every one that it goes not into an empty space, but drives the Air next to it, out of its place, which again drives away the next to it; and according to this necessity whatsoever is driven into the place, whence the breath came forth, doth follow it. And all this is perform'd at once by a certain Revolution, since there is no vacuity any where. Wherefore as soon as the Breast and Lungs have let out the Breath, they are immediately fill'd again with the Air that surrounds and penetrates the Pores of the Body. And again the Air flying out of the Body, and the let out breath, forceth us to draw in our breath again, by the Passages of our Mouth and Nostrils.*

XV. *Motion is not contrary to Motion, but to Rest.*

One *Motion* is not contrary to another *Motion*, because when two *Bodies* of the same *Bigness* and *swiftness* meet, they do not lose their *Motion*, but are only reflected, and then so continue their *Motions* again. But *Rest* alone is contrary to *Motion*: And tho' a *slow Motion* may be said to be opposit to a *swift*, that is only because a *slow Motion* partakes of *Rest*.

XVI. *What Rest is.*

For *Rest is a Continuance of a thing in the same place*, or *an adhæsion to the same Contiguous Bodies*. This is an *Affection* proper to *matter*, which consider'd simply in it self: without any force from without impress't upon it, continues unmov'd, that is, hath its parts *continuous* to it self. Now this *Rest* or *Quiet* is something *Positive* as well as *Motion*: For *Rest*, according to its *Magnitude*, resists *motion* more or less, alters the determination of *motion*, and keeps the parts of continuous and hard *Bodies* close together, which could not be done by that which is meerly *Privative*. And indeed forasmuch as *Rest* is something stable and permanent, if compared with *motion*, which *is flowing and passing*, we cannot deny it Reality.

XVII. *Rest is opposit to Motion.*

Rest therefore is oppos'd to *motion*, not Privatively, as *Habit* and *Privation*; but *Positively*, as two contraries, whereof the one is contrary to the other; for *Rest* is adverse to *motion* by resisting it, and that either by diminishing it, or reflecting it.

XVIII. *Motion and Rest are only Modes of Things.*

Motion is not a *Real Quality*, as the *Peripateticks* suppose, but only a *Mode* which is not distinct from the *Body*. For we cannot conceive it to be any thing else, but the *change* whereby a *Body* is translated, or withdraws from some other *Bodies* that immediately touch it. As when standing on the *Bank* of a *River*, we see a *Fish* for some time continuing over against the same *place*, without being carried away by the course of the *Water*, which on all sides surrounds it, we must conclude it to be really *moved*, because the whole outside of the *Fish*, is successively apply'd to diverse *parts* of the *Water* that do immediately touch it; and because we find all that in it which happens to another *Fish* that *swims* in a *Pond*; and moreover the effort he useth makes him successively to correspond to different parts of the *VVater*. And on the contrary when we see a *Stick* driving in the *VVater*, so as to be always apply'd to the same parts of the Water, we must say that it doth not move, but lye still, forasmuch as the said Stick is without any *Action* of its own, and doth not correspond successively to divers Parts of the *VVater*, because a *Stick* in this case, and the *VVater*, make up but one thing, which is really moved.

XIX. *Motion and Rest are the Modifications of a Body.*

As we cannot conceive an Application to be made to different *Parts*, without conceiving a *Body* that applies it self to them; therefore we are to judg, that *Motion* is not an Absolute *Entity*, as hath been said before, but only the Modification of a *Body* that is moved; and so *Rest* likewise the *Mode* of a *Body resting*. Whence it appears, that *Motion* and *Quiet* superadd nothing more to a *Body* moved or *Resting*, than *Figure* superadds to a *Body* figured. And seeing that a *Body* may either be moved, or not moved, we must conclude, that *Motion* and *Rest* are Accidental to *Matter*.

XX. *There is no violent Motion in Nature.*

We may also infer from what hath been said, that there is no violent *Motion* in *Nature*, since it is as connatural to *Bodies* to push forwards one another, as to rest and lye still. For *Matter* consider'd in it self, being idle and unactive, and receiving its motion from an *External Principle*, it follows that *Motion* equally agrees to all *Bodies*. Neither can the *Motion* of a *Stone* cast upwards, be said to be violent, any more than the *Motion* of a *Ball* when it falls down perpendicularly to the *Earth*: For as the *Motion* of a *Stone* cast up into the *Air*, proceeds from the force of him that casts it up; so the descent of a *Ball* proceeds from the subtil matter which carrieth the *Earth* and compresseth all its parts towards the *Center*. For the word *Violent* hath reference only to our *Will*, which is said to be forced when any thing happens to it, which it resists and strives against.

CHAP. XV.

Of the Principle of Local Motion.

I. *There are two Principles of Motion.*

FOrasmuch as Matter hath no power to attribute any *motion* to it self, or to remove another *Body* out of its place (as shall be said in the following *Chapter*) we are to enquire here what is the *Cause* of *motion* in the *Universe*. In which enquiry, that we may follow the order we see in the *World*, we shall *pitch* upon two *Principles* of *motion*; the one *General*, on which all *motions* in the *world* do depend; and the other *Particular* or secundary, to which all singular *motions* are attributed.

II. *God is the first Cause of Motion.*

The *First* and *Universal Cause* is that which first put *matter* into *Motion*, and is no other but *God* alone, who bestowed *Motion* upon the *matter* he had *created*, and preserves the same by the same *Action* by which he produc'd it at first; and because it is agreeable to *Right Reason*, and the *Idea* we have of

of *God*, that he should conserve his *Creatures* in the most simple way; it seems more than probable that *God* continues the same *Agitation* in the *Universe*, which he impresst on it at first, yet so as that he can always whensoever it pleaseth him change these *Laws*, which he hath establisht.

III. *The Second Cause is the meeting of other Bodies.* The *Second* or Particular *Cause* is the meeting of *Bodies*, by which means it happens, that this *Divine Action*, which preserves *Motion*, exerts it self sometimes in these, sometimes in other *Bodies*: Whence the difficulty which ariseth from the Communication of *Motion* may be easily solved; for tho' *Motion*, as being only the *Mode* of a *Body*, cannot remove from one *Subject* to another, which *Regius* unwarily asserts; yet the agitating force, being no *Mode* of a *Body*, may by removing shew it self sometimes in this, sometimes in the other *Body*.

IV. *The Communication of motion is performed according to the Laws at first set by God.* Whensoever therefore *DES CARTES* speaks of the Communication of *Motion*, he is to be understood of that *Power*, which preserves *Natural Things* in the same condition wherein they were constituted at first, and all effects order'd according to the *Laws* appointed for them, and suiting to their *Natures*.

V. *Three Laws of Nature.* There are three *Laws* of *Nature*, which are founded in that most simple Concourse, whereby *God* preserves all *Bodies*, which are very conducive to understand the *Nature* of *Motion*.

VI. *The First Law of Nature.* The *First* is this; *Every Natural thing, if it be simple and undivided, always inclines to continue in the same state wherein it is*: So that no change can happen to it, but from some outward *Principles*. Thus a *Round Body*, always keeps its Round *Figure*, neither is the same destroy'd, but by some supervening foreign *Agent*. And supposing the same *Body* to be *moved*, it will still proceed further, except it meet with some impediment that puts a stop to its *Motion*. And according to this *Rule*, we say, that a *Body* once put into *Motion*, for example, a *Ball* struck by a *Racket*, doth not stop at the *Wall* from whence it is reflected; for should we suppose any interruption in its *Motion*, we should be at a loss to find the *cause* that excites a new *Motion* in it again. Wherefore we must conclude that that which is *moved*, is always *moved*, and that which *rests*, rests always. And for this cause it is that a *Stone* continues its *Motion*, after it is let go out of the *hand* of him that throws it.

VII. *The Reason of the Foregoing Rule.* This *Rule* may easily be gather'd from what we shall say in the following *Chapter*: For seeing that a *Body* cannot move it self, it follows, that that which rests, must persevere so, except by some outward force it be driven out of its *place*. And in like manner, when a *Body* is once put into *Motion*, no reason can be assign'd why it should not continually proceed therein, with the same *swiftness*, as long as it meets with nothing that stops its career. For since nothing can be done without a *Cause*, the state of a *Body* cannot be changed without the *Action* of a *Cause*. Hence it is that a *Leaden Bullet* being let fall from the top of a *Mast*, notwithstanding the swift course of the *Ship*, yet falls down straight to the bottom; for the *Motion* of the *Bullet* being a Compound of *progressive and descensory Motion*, and both of them continuing in the same state, it is evident that the *Bullet* can fall no otherwise than it doth.

Wherefore we shall meet with no change in *Bodies*, as to *Motion* or *Rest*, *Swiftness* or *Slowness*, *Figure*, *Situation*, *Magnitude*, &c. which do not proceed from without, the searching out of which *Causes* is the particular task of *Natural Philosophy*. *Water* indeed doth by degrees lose its *Heat*, but then it is no *simple*, and undivided *Body*; for it derives its agitation from without, and retains it as long as the agitating *Cause* continues; but forasmuch as the *Cause* ceaseth, and the more thin parts of the *Water* Evaporate, and communicate their *Motion* to the Neighbouring *Bodies*, by this means the *Water* becomes reduc'd to its former state of Coldness.

VIII. *Every change proceeds from outward Causes.*

You'l say, a *Stone* cast up into the *Air*, doth after a short time fall down again to the *ground*, which would not be, if a *Body* once moved, were inclin'd to continue its *Motion*; for according to this *Rule*, it ought continually to proceed, tending upwards.

IX. *Why a Stone after some time, falls down again to the ground.*

I answer, that a *Stone* falls down to the *ground*, not because it willingly desists from its *Motion*, but because it is hindred by the *Bodies* it meets with on its way from proceeding any further. For the *Air* and *fluid* Matter that is in it, do not without difficulty admit the entring of other *Bodies*; yea and besides do very much resist them, as is obvious to our sense of *Feeling*. For the subtil *Matter*, which thrusts *Bodies* downward, hinders the *Stone* from being carried up to Heaven. So that we our selves, when we leap up from the *Earth*, should still continue in the same *Motion* mounting upwards, if the subtil *Matter* which surrounds the whole *Earth*, did not drive us downwards.

X. *Answer.*

XI. *No body moves circularly but by the intervening of outward force.* What hath been said of a *Stone* falling to the *Ground* must likewise be understood in General of all other *Bodies*: Wherefore if we see a *Body* in its *Motion* describing the four sides of a *Square Figure*, we must conclude that at every one of the said *Angles* where it changeth its determination, it hath been forc'd to it by the meeting of some other *Bodies*, which have oppos'd its *Motion* and determination. And forasmuch as a *Circle* is Equivalent to a *Figure* of an infinite number of *sides*, it follows, that a *Body* which is circularly moved, must suffer a continual violence by meeting with several other *Bodies*, for without this it could never move in a round *Line*.

XII. *Another reason why Bodies persevere in their motion.* But the chief reason that moves us to assert, that a *Stone*, or any other *Body* would persevere in its *Motion*, if we were not hindred by other *Bodies*, is, because *Rest* is contrary to *Motion*, and nothing by its natural Propensity tends to its contrary, that is, to its own *Destruction*; and consequently a *Body* if once *moved* will move always, or if at *rest*, will always continue so. And in this *Principle* alone we place the *Power* of the *Action* and *Resistance* of *Bodies*. For as a thing that is *united*, hath a Power to resist its being separated from that which *rests*, to oppose that which would put it into *Motion*; so that which is moved hath a *Power* to continue in its *Motion* with the same Swiftness, and towards the same place.

XIII. *Why a Body ceaseth to move.* Thus a *weight* hanging at the end of the *Packthread* A *B* which by outward force is mov'd this way and that way, if it were tranfmitted to G, would fall down thence, and mount up to D, and always retain this *Equality* of *Motion*; neither would it ever, by slackning of its *Motion*, come Figure 5.

down to E and F, but that the *Air* hinders it from continuing its begun *Motion* from G to D. Forasmuch as no reason can be assign'd, why that which is, should cease to be, except a more powerful thing do hinder and oppose its force.

XIV. *The Second Law of Nature.*

The *Second* Law of Nature is this: *Every Body in Motion, of it self tends to prosecute its Motion according to a right line, and not according to a crooked line.* Notwithstanding that, many *Bodies* are forc'd to turn aside by their meeting or justling against other *Bodies*, and that, as hath been said before, the whole *circle* of *Bodies* moves together in every *Motion*. This *Rule* is infer'd from the Definition of *Motion*, because it affirms nothing concerning *Motion*, save only that it is *a Translation of one Part of Matter, out of the Neighbourhood of those Bodies that do immediately touch it*, &c. *into the Neighbourhood of other Bodies*. So that except this Translation be most simple, that is, by right *lines*, and not crooked, we have attributed something to *Motion*, which is not contained in the *Essential Notion* or *Definition* of it, and so consequently that which doth not belong to its *Nature*. For whatsoever is moved, in every moment of its *Motion*, is determin'd *to continue its Motion* to some part or other, in a *Right Line*. Forasmuch therefore as *God* preserves *Motion* in the most simple manner that may be, and every *natural thing* continues in the state wherein it is, the *Body* moved will always continue its *Motion* in a *Right line*, except it be hindred from without.

XV. *Why every Motion tends to a Right Line.*

If you demand why every *Motion* tends to a *Right Line*, and not to a crooked? I answer, because all the least parts that are found in a *Crooked Line*, are right *Lines*; and since the circulating *Body*, ultimately exists in one of them, it follows according to the former *Rule*, that as soon as it is restor'd to its Liberty, it perseveres in the same state, and continues its *Motion* in that *Right Line* which there toucheth the *Circle*. But if the least parts in the *Circle* were *crooked*, the moved *Body* being continually carried along them, and afterwards left to its Liberty, according to the foregoing *Rule*, would pursue a *crooked Motion*, conform to the *crooked particle* of the *Circle* where it was last: But since this doth not happen, it is manifest that every *Circle* in Nature is a *Polygon*, or a *Body* of many *Angles*.

XVI. *Both these Laws demonstrated from the Divine Immutability.*

This *Rule* of *Nature*, as well as the foregoing, may be domonstrated from the consideration of the *Divine Perfection*, that is, from the *immutability* and *simplicity* of that operation whereby *God* conserves *Motion* in the *Universe*. For as *God* preserves *Motion* in any *Body*, by making that *Motion* which now is, to continue to exist, without any regard had to the state wherein the *Body* was before; so he likewise continues to direct the *Body* moved to that *Term*, to which it is directed, at the present instant of *time*. But there is never any instant of *time* wherein it is not disposed to continue its *Motion* in a *Right-Line*, tho' before it was carried in a *crooked line*, and accordingly will pursue its motion in a *Right-Line*. This is clearly made out by *DES CARTES* in the 2d part of his *Principles*, *Artic.* 39. by the example of a *Stone* A, whirld about in a Sling A E, which tho' it be turn'd round in the *Circle* L A B F, yet withal hath a tendency towards the Tangent *Line* A C G. For tho' the *Stone* first proceeds from L to A by a *crooked line*, yet nothing at all of that Obliquity can be understood to abide in it, whilst it is in the *Point* A. Because tho' the *Stone* be moved round, yet forasmuch as in every moment of *time*, parts may be assign'd that have no crookedness at all, it cannot be suppos'd to retain any obliquity, when the detaining force ceaseth.

Figure 6.

XVII. *The Circular Motion of a Body proceeds from a Cause External.*

Hence it follows, that no *Body* of it self is moved in *a Circular Motion*, forasmuch as that always proceeds from an outward *cause*, which hinders the *Body* moved to pursue its *Motion* in a *Right Line*. Upon this account it is also that *Wooden Bowls* dashing against one another, are often whirld round; and so *Water* likewise, when it is hastily poured into any *Vessel*: Yea, in every motion there is a circulation of *Bodies*, as shall be shewed hereafter.

XVIII. *Every Body that's whirld round, endeavours to recede from its Center.*

Another Consectary is, that all *Bodies* circularly moved, do either actually recede, if they be not hindred; or endeavour to recede, if they be, from the *Center* of their *Motion*: Because, as soon as the detaining force ceaseth, they begin to move in a *Right Line*. This is the reason why the *Water* doth not fall down out of a *Bucket* of *Water* as long as it is whirld round; and that it strives to recede from the *Center*, we may gather from hence, because upon making a *Hole* in it, the *Water* runs out immediately. This Rule is of very great use for explaining of the *Heavenly Phænomena*. Now this strife of receding from the *Center*, is either greater or lesser, proportionable to the *Agitation*, as ony one may plainly perceive in the whirling about of a *Sling*.

XIX. *And that which is strongest doth the more recede from the Center.*

Forasmuch therefore as all *Bodies* moved round, strive to continue their *Motion* in *Right Lines*; it follows, that when many *Bodies* are so moved, every one of them must strive to move by the *Tangent* A C G of the *Circle* which it describes; and really move by the same *Line*, as soon as the *causes* that have hindred it be taken away. It is visible also that the most strongly moved *Bodies*, must at the same time describe longer *Tangents* than those that are more weakly moved, and consequently more withdraw themselves from the *Center* of their *Motion*, and by the same means force the weaker *Bodies* to approach to the *Center*.

XX. *The Third Law of Nature.*

Another *Rule* is; *Whensoever the Moved Body, meets with another Body in Motion, if it have not as great a force to pursue its course by a Right Line, as there is in the other Body to hinder it, then it is turn'd out of its way, but yet continuing its Motion, loseth only the Determination of it.* As it is evident in *hard Bodies*, which when they dash against another *Body*, don't therefore cease to move, but are reflected to the opposit part. But if one of them have a greater force than the other, then it pusheth it along, and as much of its own force as it imparts to this other *Body*, so much it loseth; as when a *hard Body* meeting with a *soft*, by communicating its own *Motion* unto it, ceaseth to move and lies still. Wherefore we are not to suppose that when a *Ball* is thrown into a *Heap* of *Sand*, that its *Motion* is lost, but that it is communicated first to the *Particles* of *Sand*, next to the *Air*, and other neighbouring *Bodies*, notwithstanding the said communication be not visible to our *Eyes*.

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XXI. *The Reason of the Third Rule.*

The Reason of this *Rule* is to be fetch'd from the *First*; for seeing every thing inclines to continue in the state wherein it is, it will follow that that which is weakest must be changed by the stronger, as experience teacheth.

XXII. *From this Law arise those changes which happen to Bodies upon their meeting one another.*

From this *Third Law* ariseth almost all the changes we find in *Bodies*, caused by the various resistance and occurrence of other *Bodies*; the effect of which occurrence will be different. *First*, according to the magnitude of those *Bodies*. *Secondly*, according to their *Superficies*, whereby they press upon each other. *Thirdly*, according to the swiftness and force of their *Motion*. *Fourthly*, according to the *Rest* and contact of *Parts* in that *Body* against which another dasheth, as shall be more amply shewed Part V.

XXIII. *How to measure the Quantity of motion.*

The *Quantity* of *Motion* in a *Body* is known partly by the *length of the Line* which the *Body* moved runs through; partly from the *quantity of its Bulk*, which is transferr'd together with it. Thus a *Square* Body of one *Foot*, being moved the length of 10 *Ells*, is said to have a certain *Quantity of Motion*, which would be double, if an equal way, were added to the former length, which that *Body* shall run through. Again, if a *Square Body* of one *Foot*, should run through the space of 10 *Ells*, there would be a double portion of *Motion* in it, with respect to a *Square Body* of half a Foot. Whence it follows, that *Bodies* of different magnitudes, may have the same *quantity* of *motion*. Thus the *Square Body of one Foot*, and that *of half a Foot* would have the same *quantity* of *motion*, supposing the former to run through a *Line* of *five Feet*, and the other a *Line* of *ten Feet*.

XXIV. *Unequal Bodies may have an Equal quantity of motion.*

From hence it is evident, that to the end two *Bodies* of different *magnitude* may have an equal *quantity* of *motion*; it is necessary that the *Lines* they run through, be reciprocally taken according to their bigness. As supposing one *Body* to be thrice as big, as another, it is necessary that the *Line* it describes by its *motion*, be only the third part of the *Line*, the lesser *Body* runs through. And upon this ground we may build these four following *Maxims*.

XXV. *The First Maxim.*

Two equal *Bodies*, have equal *Quantities* of *motion*, when in equal *time*, they describe equal *Lines*.

XXVI. *Second Maxim.*

Two equal *Bodies* have unequal *quantities* of *motion*, when in *equal time*, they describe *unequal Lines*.

XXVII. *The Third Maxim.*

Two *unequal Bodies* have equal *quantity* of *motion*, when in an equal space of *time*, they describe *Lines*, which are of a reciprocal Proportion to their *magnitude*.

XXVIII. *The Fourth Maxim.*

Two *unequal Bodies* have unequal *Quantity* of *motion*, when in equal time they describe *Lines* which are not reciprocal to their *Bulk*.

CHAP. XVI.

A Body can neither move it self, nor another Body.

I. *Motion is something distinct from the force that moves.*

TO know whether the *Body* moved hath its *motion* from it self, or whether it receives it from some outward *Cause*, we are to suppose two things in *motion*; the one residing in the thing *moved*; and the other in the *mover*: The former of these is the successive application of the *Body* moved, to the different parts of the *Body* that doth immediately touch it; and the second is, the force that causeth this application. *Motion* in the *thing* moved is nothing else but a *mode*, as hath been said in the foregoing *Chapter*; and consequently cannot pass from this *Body* into another, because every *mode* is inseparably tyed to its *Subject*. But *motion* consider'd with spect to the *mover*, is not a *mode* of the *Body* moved, because we find by experience that it passeth from that *Body* into another; so that *motion* in the first Sense, is only *modally* distinct from the *Body*, whereas the efficient *mover* is *Really* distinct from it.

II. *Every Body is moved by another.*

It is evident therefore that a *Body* hath not its *motion* from it self, in the first of these *Senses*, because this *motion* consists in an *Application* which is *Accidental* to the *Body*; and that every change which happens to any *Subject*, proceeds from an *External Cause*. Neither can it give it self the *Efficient motion*; because this *motion* likewise is Accidental to the *Body*: Wherefore it follows that the *Body* must receive its *motion* from something that is without it.

III. *A Body may not be moved at all.*

Moreover, a *Body* cannot be said to have that of it self which it may lose, without ceasing to be what it is; now it is evident that every *Body* can wholly lose its *Motion*, without ceasing to be a *Body*: Wherefore we must conclude that no *Body* has any *motion* of it self.

IV. *If a Body were mov'd of it self, it would be in perpetual motion.*

If a *Body* of it self had the *Power* to move it self, this *Power* would be *Essential* to it, and consequently the *Body* would move always, and with the same force, which is contrary to experience, which teaches us that a *Body* sometimes moves more, and sometimes less, and sometimes not at all: Wherefore it receives its force to move from something without it. Now there is nothing without or external to *matter* but *Spirit*; it is *Spirit* therefore that moves the *Body*, that is to say, *God*, who makes the parts of *matter* apply themselves successively, as to their outsides, to other parts that *immediately* touch them. Wherefore, since *God* cannot produce *motion* without acting, nor act otherwise than by his *Will*; we must own that the moving *Power* is nothing else, but the *Will God* hath to move the *matter*. Whence it follows also, that as the *Will* of *God* is unchangeable, the quantity also of the moving force must always continue the same, and that if it change by encreasing or diminishing, this is not with respect to its *Principle*, but with respect to the different *Bodies* on which *God* exerts that *Power*, as we have already shewed.

V. *Neither can a Body move another Body.*

From whence we gather this Conclusion also, that no *Body* can move another. For how shall it move another *Body*, seeing it cannot move it self?

VI. *The Power of moving differs from the thing moved.*

If you say that the *Power* of *moving* is not distinct from the *thing moved*, and that therefore it is not repugnant for a *Body* to apply it self to divers places: If it were so, it would follow that the *force* whereby *God* produceth *motion* in the *Universe*, must include the notion of *Extension*; and seeing the same is not distinct from *God*, it would follow, that *God* is *Corporeal*.

VII. *Aristotle teacheth that no Body can be moved by it self.*

Wherefore, *ARISTOTLE* 8 *Physic. Chap.* 4. tells us, that *no Body can be moved by it self*, and consequently that *Heavy* and *Light Things* are not moved of themselves, but by others. For if they could move of themselves, they might also stand still of themselves; for whatsoever is a cause of *walking* to it self, is also the cause of not *walking*; wherefore if *Fire* of it self did move upwards,

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it would also be able by its own strength to move downwards. *For it is not*, saith he, *agreeable to Reason, that those things should only be moved one way, that do move themselves. Moreover, how can it be that a continuous thing should move it self? For as far as any thing is one and continuous, it is not capable of Passion: But as soon as it is separated, then one can act and the other suffer. Nothing therefore moves it self, because every thing is one and connext; nor another, that is one continuous thing with it, but in every thing it is necessary that that which moves, should be divided from that which is moved.*

VIII. *Bodies have only a Dispositive Principle to motion.*

And tho' *ARISTOTLE* in the place before quoted, seems to own a *Principle* of *Motion* in *Inanimate Bodies*, this is only to be understood of a *Dispositive*, and not of an *Active Principle*; after the same manner as a *Knife*, *Sword*, *Leaver*, or any other *Engines*, are fit or disposed to act something, and do moreover act and move, when they are employ'd by an *External Agent*, but never can set upon a work of themselves.

IX. *The moving force is different from the moved.*

To make this the more evident, let us suppose that all the parts of *matter* from the *Beginning* were destitute of all *motion*, and to have lain mingled together, having Extension only. Which of all these think you, would have begun to move first? Or what force could they have had to move either themselves or others that touch'd them? Seeing therefore we can conceive nothing there, besides *Extension*, and that *Motion* is not an effect of *Extension*, we must say, that none of them could have the *Power* either of *moving* themselves or other *Bodies*. And what we conclude of the several *parts* of the *matter* contained in the *Chaos*, the same we must conclude of the whole: For whither could that vast *Body* move, seeing that it is indefinitely extended, and we can conceive no *Bounds* or *Limits* in it?

X. *Supposing things to be without motion, there is nothing whence they should be moved besides God.*

We must conclude therefore, that no *Body* can move *it self*, since the force of moving is distinct from it; nor *another Body*, since a *Body* that moves another must lose as much of its own *motion*, as it imparts to the other *Body*: But how shall it impart that which it hath not? Wherefore *God* must be concluded to be the *Author* and *Principle* of all *motion* in the *World*.

XI. *How Animals move themselves.*

If you object, that *Animals* do move themselves, without requiring an *External Cause* by which they might be moved. *I answer*, that the *motion* of *Animals* depends on that of *the Animal Spirits* which being of a *fiery nature*, and carried through the *Body* like a *Flame* or *Wind*, do easily move the *Members* of it. For in the *Animal Spirits*, besides the thinnest and most moveable *Particles* of the *Blood*, is also contained much of the *Cœlestial matter*, which because of the extream subtilty of its *Parts*, is perpetually and necessarily agitated. Forasmuch therefore as these *Spirits* being either simply moved or determin'd, or besides also altered, do easily diffuse themselves into the *Nerves*, which are extended from the first Original of *Sense* and Motion to the *Muscles* and parts to be moved; it is not difficult to conceive how the *Figure* of the *Muscles* being changed by the *Influx* of *Spirits*, by their contraction or extension, do contract or extend the parts to which they are joyned, and consequently can be moved with innumerable different *motions*.

CHAP. XVII.

Concerning those Motions which commonly are ascrib'd to Nature's avoiding of a Vacuum.

I. *'Tis absurd to attribute knowledg to Bodily things.*

SOme are so liberal as to allow *Knowledg* indifferently to all *things*, and suppose *Inanimate Things* to be indued with a kind of *Intuitive Perception*. For if you demand of them why a *Stone* tends downwards, why *Water* gathers up it self into round drops, why *Plants* delight in such and such ground; they have a cause ready at hand, *viz.* That *a Stone* tends to the *Center* of the *Earth* to rest there; that *Water* affects a Round *Figure*, to preserve it self from its *Enemy*; and that *Plants* delight in such a *Soil*, because they know their convenient *Aliment*; and that *Water* mounts up on high, to avoid a *Vacuum*, and to preserve the *Union* that is between *Bodies*. Yea, we shall hear some boldly asserting, that the *Earth* for no other *Reason*, took to it self a *Sphærical Figure*, than that it might be able, to resist the impulses, of the *Heavenly Bodies*; and that as with an *Army* in *Battle-array*, it might be in a better condition to oppose its Adversaries which on all sides press in upon it.

II. *The improper Answer of some Men.*

Thus they tell us, that the *Water* mounts upwards in *Hero's Fountain*, because *Nature* abhors a *Vacuum*. Which way of speaking hath always appear'd very strange to me, and much like that, as when a *Man* being demanded why *Coals* are brought to *London* from the *North* parts of *England*, should answer, *for fear of Cold*: For these answers do not in the least satisfie the Question, which is not concerning the *Final*, but the *Efficient Cause*. Neither indeed can the *Avoiding of a Vacuum* be said to be the *Final cause* of the *Waters Ascent*; First, because the *Fear of a Vacuum* is vain; neither can Nature abhor that which cannot be; and consequently a vain cause is ascrib'd to those *Natural Effects*, which are supppos'd to proceed from this *fear*. *Secondly*, forasmuch as this *Fear* is perpetual, and that there is a continual necessity that all *Bodies* be united together, therefore the *Water* ought to ascend perpetually, which is contrary to experience; for we find that in *Spouts* and *Pumps* the *Water* ascends only to a certain degree, *viz.* to *thirty one Foot* and an half, where its stops, and can rise no higher.

III. *Why Water can only rise to a certain measure.*

Now the Reason why *Water* can only be raised to a certain height, is this, because the weight of the pressing *Air*, is then, as it were of an equal poise with the weight of the *Water* that is driven upwards; so as that the force of resisting in the *Water*, becomes equal to the pressing force that is in the *Air*. Thus by Example, from the *waters* mounting continually in *Pumps* to the height of about 31 Foot and an half, above the *Surface* of the *Water* in which the end of the *Pump* is dipt, they conclude that a *Column of Water* of that height weighs as much as a Column of *Air* of the same bigness, how high soever it may mount.

IV. *No Body is moved but by that which immediately toucheth it.*

Now to the end that the Cause of these *motions* may be the better understood, we'l take for granted what hath already been proved, that no *Body* moves it self, but must be moved by another *Body*, that immediately toucheth it, pushing against it: And forasmuch as in all the *Instances* we shall here alledg, nothing is found besides the *Air*, that toucheth

toucheth the *Bodies* moved, we must conclude that they are pusht on by the *Air*. Moreover considering that the *Air* always retains a great *Quantity* of *watry Particles*, which tho' dispersed in divers places, do notwithstanding retain their own *Heavinesse*, we cannot doubt that the *Air* is *Heavy*, and that by its weight it presseth the *Bodies* it lies upon. As may be seen in a *Syringe*, out of which if we draw the *Sucker* a little way, it of it self runs to the bottom again, because the *Air* that is above it, and immediately toucheth it, by its *weight* presseth it down to the bottom.

V. *In every Motion the whole Circle of Bodies moves.*

Moreover, we are to suppose, that seeing there is no *Vacuum* in *Nature*, when one *Body* is moved, the same must come into the place of other *Bodies*, and that which is driven out, must at the same instant take up the place of another *Body*, and so consecutively one after another, till the last *Body* enters into the place which was left by the first; so that all *Motions* in the *World* are in some sort *Circular*.

VI. *How those Motions are performed which are commonly ascribed to the fear of a Vacuum.*

These things so far understood, it will be easy to apprehend, that all *motions* which are ascribed to the fear of a *Vacuity*, are produced, for that some *Body* being pusht out of its place, does as much for the *Body* that is next to it, and so on, till the last *Body* enters into the place left by the first *Body*.

VII. *How the Water comes to ascend by a crooked Pipe.*

This *motion* is evident in a *Bent* or *crooked Pipe*, the shorter leg whereof B A D being put into the *Vessel* E, fill'd with *Water* (for it is supposed that the *Liquor* which is in the part of the *Pipe* F D, as standing in a liquor of equal *Heavinesse*, is not at all pressed by it, and therefore has no gravitation at all) and the longer Arm B C being extended towards the *Earth*; The *Water* that is inclos'd in the longer *Arm*, being heavier because of its *greater Quantity*, than that which is in the short Arm B A D, it must needs by reason of its *Weight* fall out of the *Pipe* B C into the *Air*, and by driving that out of its place, presseth the surface of the *Water* D, and makes the *Water* to ascend by the short *Arm* D A B, from whence it is carried to that *place*, which the *Water* falling down out of the *Arm* B C, hath forsaken. For seeing that the surrounding *Bodies*, have no place whither to withdraw themselves, they hinder the *Water* and *Air* from entring. But in the longer *Arm* B C whence the *Water* falls down, room is made, which the *Water* thrust down by the pressing *Air*, may take up at the same instant.

Figure 7.

VIII. *How long this ascent and descent continues.*

And the *Water* runs in this crooked *Pipe*, as long as the shorter *Arm* B A D, is depressed, or not of an equal height above the surface of the *VVater* with the other *Arm* B C. But when both the Arms are of an even height, the outflowing of the *VVater* will cease, for being equal, the one cannot prevail over the other. And if then the same ascent and descent of the *VVater* should continue, it would follow that there must be a greater quantity of *VVater* in the *Arm* B C, than in the *Arm* B A F, which is contrary to our supposition.

IX. *Why the flux of the water is by little and little diminished.*

This shews clearly why the *flux* of the *liquor* from these Pipes is swiftest at the first, and afterwards decreaseth by degrees, because the *Arm* from whence the *Water* runs out, is at first higher than the other, which height being continually lessen'd by the *efflux* of the *Water*, the swiftness of the *motion* of the liquor must be proportionably diminished. And when both the *Arms* are of an equal height, the *efflux* must cease, and the *Water* be at a stand in them both.

X. *The Motion of Water through a Pipe cannot be perpetual.*

Wherefore no wonder that they lost their labour who endeavoured by the *weight* of the *Water* in a crooked Tube A B C to find out a *Perpetual Motion*. For observing that much *Water* was contained in the wider *Arm* A, and that the longer *Arm* C contained only a little *Water*, they hoped that the *Water* enclos'd in the *Arm* A, because of its quantity and *weight*, falling down through the hole F, would have sufficient force to press the Air G, and by means thereof also pressing the surface of the *Water* D, contain'd in the Tube E, might drive the Water through the longer Arm C, into the Arm A, and from thence falling down again through the Hole F, of the wider Tube, into the Tube E, might produce a perperual *motion* of the ascending and descending *Water*.

Figure 8.

XI. *The Reason of the former assertion.*

But this was but a vain attempt of theirs; for tho' all the *liquor* contain'd in the wider *Arm* A, be much more heavy than what is in the longer *Arm* C, yet because the *Water* that is contain'd in the *Globe* A, doth not with its whole *Body* press the subjacent *Air*, but only with that part of it which perpendicularly answers to the *Hole* F, it cannot remove the *Air* that is under it out of its place, and consequently neither can it repel the *Water* contain'd in the *Arm* C B, into the other *Arm* B A, because the *Water* in C B exceeds that in weight which in the *Arm* A perpendicularly answers to the *Hole* F. And the reason why the whole *liquor* which is contained in the *Arm* A, cannot press all the subjacent *Air*, is, because the other parts of the *Water* contain'd in the longer *Arm*, falling down perpendicularly, tend directly to the parts of the *Arm* H I, diametrically under them, and therefore no wonder if they cannot press the subjacent *Air*; otherwise the *Water* F B, which is the lighter, would by its pressure raise up the heavier D C B, which no *Naturalist* can admit.

XII. *How water is drawn out of a vessel by a Filter.*

The same *cause* that makes the Water ascend by the foresaid *crooked Tube*, raiseth it likewise by a long shred of *Cloth* or *Linnen*. For first of all the *piece* of *Cloth* must be well dipt in the *Water*; because as long as that part which hangs down without the *Vessel* is dry, no *filtration* will follow: Now the outward parts of *Water*, wherewith the Cloth is made wet, do so insinuate themselves between the Threads of it, as to make a kind of *Tube* or *Pipe* (but into which no *Air* can enter) and in the mean time the consequent parts of the *Water*, which are contained in the said *Pipe*, flow towards that part of the *Cloth*, which hangs lower down on the outside of the *Vessel*, in like manner as it happens in the *crooked Tube* or *Pipe*.

XIII. *How the Air is drawn into a pair of Bellows.*

Thus likewise we see how a *Bellows* by being distended, becomes filled with *Air*; for seeing all places are full, and no Vacuity is found in the *Universe*, by distending the *Bellows*, the *Air* is driven out of its place, and finding no other passage, is forced to enter by the *Nuzzle* of the *Bellows*.

XIV. *How the Air in Breathing enters into our Breast.*

Respiration also is performed in us much after the same manner: For the *Air* entring into our *Bodies*, dilates the same by means of the *Muscles* of the *Breast* and *Stomack*; whereupon the neighbouring *Air* because of its fluidity is easily turn'd

out of its place, and consequently drives before it that also which is next to it, and thus the *Air* being pusht by the *Breast*, and other subsequent *Air*, is thrust down through the *Winde-Pipe* into the *Lungs* and *Breast*, and from thence also does return the same way. For *Respiration* is nothing else but an Alternate expansion and contraction of the *Breast*, by which the *Air* is thus driven to and from the Lungs.

XV. *Respiration cannot be performed by Attraction.*

By this experiment we may solve all, or most at least of those *Phænomena*, which *Philosophers* have attributed to *Attraction*. For it cannot be understood how in *Respiration* the *Air* is suckt in, or by what means the *Lips*, *Lungs* or any other part of the *Body* can hook in the little *Particles* of the *Air* and attract them: But when the inward parts are dilated, we easily apprehend that at the same time they push away the neighbouring *Air*, which partly by this *pressure*, and partly by the *Elastick virtue* caus'd by the Agitation of its *Particles*, is driven into the *Breast*, and afterwards expell'd again, *viz.* when the *Lungs* subside again and are contracted.

XVI. *How the Flesh of mans Body comes to rise up into the Cupping glasses.*

We must not omit here the Experiment of *Cupping Glasses*, by means whereof the *Flesh* is raised in order to *Scarification*, and by force driven into them. For the *Air* being in a manner wholly expell'd out of the *Cupping Glasses*, by the intromission of *Fire*, it must thereupon be condensed, and its parts more closely prest together, than is consistent with its temperament: And therefore whilst the *Subtil Æther* crouds in betwixt its *Particles*, this External *Air* strives to dilate it self again, and to return to its natural state: And in this strife it presseth all the *Bodies* that do surround it, which as long as they strive against this force, no *Bodies* are turn'd out of their *Places*. But when the *Air* in the *Cupping Glasses* begins to grow cold, it hath no power any longer to resist the pressure of the *Air* striving to dilate it self, and therefore suffers the outward *Air*, by pressing the *Flesh* to thrust it into the *Cupping Glasses*, and to drive out the *subtil matter* which was contained in them through the *Pores* of the *Glass*.

XVII. *Much in the same manner as the water mounts upwards.*

Almost in the same manner as we see the *Hand* in a *Pneumatick Engine* (after that the *Air* is exhausted out of the *Recipient* or *Glass Vessel*) to swell and spread. And for the same reason, a *Viol* with a narrow *Mouth*, if the *Air* by sucking be drawn out of it, and afterwards you stop the Hole of it with your *Finger*, and so dip it into the *Water*, it will become fill'd with it; because the Ambient *Air* by its weight pressing the *Surface* of the *Water*, drives it into the Viol, in which the *Air* that remains, being rarefied, for the want of the *Air* that is extracted, retains only a weak *Elastick force*, and so cannot oppose the pressure of the outward *Air*.

XVIII. *How Infants suck Milk out of their Mothers Breasts.*

Hence it also appears how improperly *Infants* are said to *suck Milk* ont of their *Mothers Breasts*: For if we consider how a *Child* draws *Milk*, we shall find that he doth not attract it by *Sucking*, but that it is driven into his *Mouth*: For the *Child* when it is about to *Suck*, doth dilate his *Cheeks*, and lay hold of the *Nipple*, wherefore the *Air*, that is next to his *Cheeks* must be driven out of its place, which pressing the *Breast* of the *Mother* or *Nurse*, drives the *Milk* into the *Childs Mouth*. And accordingly also *Nurses* use to press their *Breasts*, to faciliate the Expulsion of the *Milk*. And the same doth yet more clearly appear in *Brute Animals*; for *Lambs* use to thrust their *Heads* against their *Dams Dugs*, thereby to squeeze out the *Milk* into their *Mouths*.

CHAP. XVIII.

Of the Determination of Motion both Simple and Compound.

I. *What the swiftness, Determination and Quantity of motion is.*

HAving explain'd the Nature of *motion*, and determined the *Causes* of it, it remains now that we discover its *Properties*, and the *Accidents* that accompany it. The inseparable Properties, of *motion* are *Determination*, *Swiftness*, and *Quantity*. For every *Body* that is moved, moves some way or other, runs through a certain *Space* in a certain time, and that *Space* may be divided into certain degrees. Insomuch that the respect which *Bodies* moved have to the Coast towards which they are moved, is called *Determination*; the respect which they have to the *Space* they run through in a certain time, is called *Swiftness*, and this *Swiftness* distinguisht into degrees, that is, into equal *Parts*, is called the *Quantity* of *motion*.

II. *What the Determination of Motion is.*

The *Determination* of *motion* is that whereby the *Body* moved, is directed from the *Term à quo*, to a certain Term: Such as is that disposition in a *Stone*, whereby it tends rather to the *Center* of the *Earth*, than towards any other part whatsoever. We shall the better understand its *Nature* by dividing *motion* into *Straight*, *Circular* and *Mixt*. *Straight motion* is a Translation by the shortest way that can be, *viz.* by a *Right Line*. *Circular* motion is a *Translation* about a *Center* and *Axis*. And *mixt motion* is that which is compounded of a *Circular* and *Straight Motion*, or of two straight ones, or innumerable other various *motions*. As the *motion* of a *Knot* in a *Wheel* about the *Axle-tree*, which is circular, and also straight with respect to the way along which it goeth.

III. *How a mixt motion may be compounded of two straight motions.*

And that a mixt *motion* may be compounded of two *right motions*, is evident, when in the square Figure A B C D, the uppermost side A B, is moved with a straight *motion* towards the opposite side C D, and that at the same time the point A, of the upper side A B, be moved towards B, the other extremity in a straight *motion*. For by this means the *point* A, will not describe a Perpendicular A C, but a Transverse *Line* A D, yet a straight one, which *Geometricians* call a *Diagonal*, when it reacheth the opposite side C D. Figure 9.

IV. *Determination is a Mode distinct from Motion.*

These things being thus briefly laid down, I say, that *motion* consider'd in it self differs from *Determination* towards any Coast; which I thus prove. Whatsoever can be taken away from any thing, without impairing of it, that doth not constitute the nature of that thing: But *Determination* may be taken away, the *motion* still continuing whole and entire: Therefore *Determination* doth not constitute the nature of motion. The *Minor* is thus proved: Suppose the *Body* A, to move towards B, and to be hindred by the *Body* B, from going any further, A according to the *Laws of motion*, will retain its own *motion* entire: But when it pursues its *motion*, it is no more carried the same way it was before, because it is hindred by the *Body* B: Wherefore its *motion* abiding entire, and having Figure 10.

having loſt its firſt Determination, it will begin to move the contrary way: And therefore *motion* is diſtinct from Determination.

V. *The Determination of motion may be changed, without any change of motion.*

This may be proved; for that *motion*, as was ſaid before, is not contrary to *motion*, neither do they ever deſtroy one another in the ſame *Subject*; whereas one *Determination* is contrary to another, and the one deſtroys the other: Wherefore they are different. For proof of the *Minor*, ſuppoſe the *Body* A, to be bigger than the *Body* B, and to daſh againſt the *Body* B, either reſting, or more ſlowly moved, A moving more ſwiftly, will alter the *Determination* of B. But if A and B be ſuppoſed equal in bigneſs, and that with a different Determination and equal ſwiftneſs they approach to one another, they will fly back from each other the contrary way, with the change of both their *Determinations*, whilſt the ſame *Quantity* of *Motion* ſtill continues in them. Moreover, *Motion*, and its *Determination* are two *Modes*, one whereof may be ſuperadded to the other in the ſame *Subject*; after the ſame manner as *Swiftneſs* and *Slowneſs* happens to *Running*. And therefore as *Swiftneſs* may be taken away from the *running* of a *Stag*, and is actually taken away, when he runs ſlowly: So likewiſe can the Determination of *motion* be eaſily changed, the *motion* it ſelf ſtill continuing.

VI. *Motion, and the Direction of it to a certain part, have different Cauſes.*

This will appear unqueſtionable, if we conſider that the cauſe of *Motion* and *Determination* is not one and the ſame. For that force whereby the mover ſtrikes a *Ball* with a *Racket* from C towards B, is not that, by which it is determin'd to tend this way rather than another way, but wholly diverſe from it. The force of the *Racket* is that which moves the *Ball*, and could as well move it towards any other parts, as towards B. But the Determination depends on the *Situation* of the *Racket*, which ſo diſpoſeth it, as to make it to be carried to B, and might have diſpos'd it after the ſame manner, tho' it had been ſtruck another way. And therefore the Determination of the *motion* of *Bodies* does not ſo much depend on the force of the *mover*, as on the Situation of the *mover*, and circumjacent *Bodies*. Wherefore it is manifeſt, that it may happen that the *Ball* being ſtruck from C towards B, may be turn'd aſide by meeting with the *Earth* E F, *viz.* by a change of its diſpoſition, by which it tended towards B, the force of its *motion* all this while continuing the ſame, there being nothing common between them.

Figure 11.

VII. *There is no Reſt in the Point of Reflection.*

Thoſe who do not diſtinguiſh the *Determination*, from *motion* it ſelf, nor one *Determination* from another, do ſuppoſe that the *Motion* of *Reflexion* is contrary to direct *motion*; and inſtead of owning no other contrariety, but what is between *motion* and *reſt*, they aſſert, that between *reflex motion* there is a moment of *reſt*, which is abſolutely impoſſible. For this *motion* being interrupted, there would be no cauſe aſſignable, by which it might be excited anew; but rather having obtained a new way of *Exiſting*, according to the *Laws of Nature* it ought to continue in the ſame condition, as much as if it had been at *reſt* for many ages together. Neither is there any more neceſſity why it ſhould begin to move again, than why a *Triangular Body*, which by *motion* is become *Spherical*, ſhould not retain that *Figure*, as much as if it had receiv'd it from the *beginning*. Becauſe *every thing, as far as in it lies, continues in the ſame ſtate wherein it is.*

VIII. *Determination is either Simple or Compound.*

Determination is double, *ſimple* or *compound*. *Simple Determination* is that, whereby a *Body* after a ſimple manner tends to the *Term* to which it is directed. Such as is the *Determination* whereby the *Body* A, from the ſame point A, by the *right line* A B, moves towards the *Body* E F diametically oppoſite to it.

IX. *A Body falling perpendicularly upon another Body, muſt be perpendicularly reflected.*

But when a *Body* falls directly and perpendicularly from A to B, on another hard and unmoved *Body* E F, it is evident that it muſt fly back by the ſame *line* B A, ſeeing there is no reaſon why it ſhould tend to one ſide more than to another. Yea, foraſmuch as the Determination of the *Body* A, is direct from A to B, and is *ſimple*, it is neceſſary according to the *Laws* of the unchangeableneſs of *Nature*, that it always continue in the ſame ſtate, without altering.

X. *What compound Determination is.*

Compound Determination is, when the *Body* moved is after a compound manner directed to another *Body*: As when the *Body* C, from the *Point* C, by the Tranſverſe Line C B tends to the *Body* E F obliquely oppos'd to it. For the *Mode* of this tendency is compounded of a *Lateral Progreſſive* motion C G in length, and a *deſcenſory* C B in height: Becauſe every *motion* that depends on two or more cauſes, is *compound*. Wherefore, a *Bullet ſhot* out of a *Canon*, doth not deſcribe a ſtraight, but a *crooked line* only, becauſe two divers cauſes concur to its *motion*; the one driving out the *Bullet*, which by degrees grows leſs, ſince the *Bullet*, as it proceeds, communicates its *motion* to the Air, which it thruſts out of its *Place*; whereas the other motion, which is deſcenſory, is encreaſed, daily experience teaching us that *Heavy Bodies* move more ſlowly at the beginning of their deſcent, than in the progreſs of it.

CHAP. XIX.

Concerning Reflexion and Refraction.

I. *What Reflexion and Refraction is.*

FRom what hath been ſaid, may be eaſily gather'd what it is for a *Body* to be *Reflected* or *Refracted*. For ſince in *Compound Determination* the *Body* moved, meeting with another *Body*, tho' it keeps the ſame *motion*, yet only retains one part of its *Determination*; it ſo happens that becauſe it cannot go forwards, it ſuffers an *Oblique Reflexion* towards the oppoſite part; but if it can, then *Refraction*. Hence *Reflexion* may be deſcrib'd, The *Regreſs or Return that happens to a moved Body, becauſe of the meeting of another Body, which it cannot penetrate*. And *Refraction*, is *the incurvation, or change of Determination in the Body moved, which happens to it, whilſt it enters or penetrates the Medium*.

II. *Sometimes a Body is directly reflected.*

Thus if a *Body* moved directly, meets with another that is unmoveable, it muſt be reflected by the ſame *Line* by which it is directly moved, there being no cauſe to oblige it, to deſcribe any other. For example; if the *Body* G be mov'd directly by the *Line* G B, towards the Earth C E, which I ſuppoſe unmoveable, it will not be reflected by the *Lines* B A, or B F, but by the Line B G. The Reaſon whereof is, becauſe the *Determination* of the *Lines* B A and B F is *compounded*, and that no cauſe can be aſſigned, that ſhould oblige the *Body* G,

Figure 12.

G, which was moved with one only *Determination* toward the *Earth* C E, to retire from thence with two *Determinations*.

III. *Sometimes obliquely.*

But if the *Body* A be mov'd obliquely by the *line* A B, and that it meet with the *Earth* C B E, which is suppos'd unmoveable, it will be reflected by the *line* B F, which is diverse from the *line* A B. To prove this, draw through the *Points* A and B, the *lines* A C and H B, perpendicular to C E. This done, consider in the first place that the *Body* A, moving towards B, doth at the same time approach to the *lines* C E and H B, that is to say, that its *Determination* from A to B, is compounded of its *Determination* from A to C, and from A to H; or that which is the same thing, of its *Determination* from above to beneath, and from the *left* to the *right*. Consider in the second place, that the *Earth* C B E opposeth it self to the Determination from A to H, and by consequence that the *Body* A, when it meets with the *Earth*, must take a quite contrary *Determination* to that which it had, by which in an equal space of time, it must advance equal quantities; that is to say, if within a *Minute*, the *Body* A, descended by the *line* A B, to the *line* C B E, it must in another *minute* remount again from the *line* C B E by the *line* B F.

IV. *The Angle of Reflection is equal to the Angle of Incidence.*

But that we may know more distinctly to what part the *Body* or *Ball* struck, must rebound, let us describe a *Circle* from the *Center* B, at the Interval B A: For all the *Points* which are distant the same Interval from B, as A is, do meet in this *Circumference*. Now to be able particularly to determine this *Point*, let us with *Des Cartes Chap. 2. Dioptr.* erect three *perpendicular lines* A C, H B and F E, upon C E, so as there may be the same distance between A C and H B, as between H B and F E. Next let us say, that in the same space of time, in which the *Ball* hath been moved towards the *right* from A, one of the *Points* of the *line* A C, into *B*, one of the *Points* of the line H B, it must move from the lines H B, to some point of the *line* F E. For all the *Points* of this *line* F E, have in this respect the same Distance from H B, as all the *Points* of the *line* A C, and it is also as much determined to move that way as it was before. Now so it is, that it cannot arrive at one and the same time to any point of the line F E, and to some point of the circumference of the Circle A F D, save only at the point D, or at F; because there are none but these two, where they intersect one another: So that the Earth hindring it from passing towards D, we must conclude that it must infallibly move towards F. And thus you may easily see how *Reflection* is made, to wit, according to an Angle, which is always equal to that which is call'd the *Angle* of *Incidence*. As if a Ray, coming from the point A, to fall upon the point B, on the surface of a flat Looking-glass C B E, should so reflect toward F, that the Angle of *Reflection* F B E, be neither greater nor less, than the Angle of *Incidence* A B C.

V. *The Angle of Reflection is sometimes less than the Angle of Incidence.*

Yet it is not necessary that the *Angle* of *Reflection*, should be always equal to the *Angle* of *Incidence*, forasmuch as sometimes it may be greater and sometimes less. For suppose the *Body* A, to descend by the *line* A C, towards the *Body* D E, and to reach the *Center* C, in the space of one *Moment*; and that the swiftness of this *Motion*, be diminished one half in the *Point* of *Contact* C; it is evident that the *Body* A, being reflected from the opposite *Body* D E, in its *Center* C, cannot in one moment run through an *equal line*, since it is supposed to have lost one half of its *swiftness*, and therefore spending two Moments, in running through an *oblique line*, it will by *Reflection* arrive at the *Point* of the *Circle* B, and will there make the *Angle* of *Reflexion* B C E, less than the *Angle* of *Incidence* A C D. This *Reflexion* is commonly call'd from a *Perpendicular*, because the *line* of *Reflection* B C doth more deviate from a *Perpendicular*, than the *line* of *Incidence* A C. Figure 13.

VI. *When the Angle of Reflection is greater than the Angle of Incidence.*

But if the *Body* B, be carried to the opposite *Body* D E by the *oblique line* B C, and arrive at the *Center* C, in the space of two *Moments*, and that its *Motion* be encreased in the point of *Contact*, so as to become twofold swifter, it is evident that the *Body* B, rebounded by the opposite *Body* D E, must in the space of one Moment, in its ascent run through an equal oblique line, and arrive at the point A of the *Circumference* of the *Circle*; and so the *Angle* of *Reflection* A C D, will be greater than the *Angle* of *Incidence* B C E. And this *Reflection* is call'd *Reflection* to a *Perpendicular*, because the *line* of *Reflection* A C, doth less deviate from a *Perpendicular* than the *line* of *Incidence* B A.

VII. *What Refraction is, and how it is made.*

What has been said is sufficient to explain the nature of *Reflection*: We proceed now to *Refraction*, which is when a *Body* passing from one *Medium* to another doth deflect from the straight line it described. So that by the *Refraction* of *Motion* nothing else is understood, but the *Deflection* or turning aside, which a *Body* suffers in passing from one *Medium* into another. For the understanding of this *Refraction*, we are to consider, first, whether the second *Medium* resists the *Motion* more or less than the first, and whether the *Body* moved do meet it directly, or obliquely; for if it meets it directly, whether it resist more or less, it is without doubt, that the *Body* moved must in no wise change the determination of its *Motion*, in penetrating of it.

VIII. *A Body directly falling into a medium suffers no Refraction.* Figure 14.

To prove this, let us suppose the *Body* L descending in the *Air* by the *Perpendicular line* L B, and that it directly meet the *Water* which is under the *surface* C B E, which separates the two *Mediums*: This being so, I say that the *Body* L having pierced the *surface* C B E, will tend directly towards G, because the *Water* that is under that *surface*, doth resist it equally on all sides, and that there is nothing but the inequality of that resistance, that can make it turn aside.

IX. *But if it falls obliquely it is refracted.*

On the contrary, if the *Body* moved meets the second *Medium* obliquely, then of necessity it must deflect either to the *right* or *left*, according as the second *Medium* resists its Motion more or less than the first; as by example, let us imagine a *Ball* struck with a *Racket* from A, obliquely to B, to meet there, not with the *Earth*, but with the *Water*, whose *surface* is bounded with C B E, the *Ball* in this case doth not directly tend to D, but towards I, and this bending or *deflection*, which is measur'd by the Quantity of the Angle B D I, is call'd *Refraction*.

X. *The cause of Refraction.*

The Cause of this *Refraction* is the Resistance it meets with: For seeing that every thing as much as in it lies continues always in the same state, we

we can give no reason why any *Body* should deflect from the *Straight* way in which it began to move, but because it meets with some hindrance in that part from whence it rebounds. Thus when the *Body* A, after it is arriv'd to the *Point* B, is turn'd aside, and tends towards I, we must conclude that it meets with more resistance towards the left side of B, than on the right; and if it be turn'd aside towards D, that it finds a greater *Resistance* from the *right side* of B, than from the left. And therefore if we perceive that the *Water* doth more hinder the motion of the *Ball* than the *Air*, we may easily judge that the *Ball* which in the *Air* is moved from the *Point* A to the *Point* B, that from thence it may pass into the *Water*, must pursue its course towards I, and deflect from a Perpendicular.

XI. *How a Body comes to be variously refracted.*

This may be apply'd to all *Bodies* and all the *Mediums* they pass through. Wherefore this may pass for a *Maxim*, that as often as a *Body moved*, passeth from one *Medium* into another, that doth resist it more, it must be *refracted*, by declining from a *Perpendicular*. And that on the contrary, when it passeth from one *Medium* to another where it finds less *Resistance*, there it must deflect towards a *Perpendicular*.

XII. *It is requided to Refraction that a Body fall obliquely upon another Body*

I have already said that it is necessary to *Refraction* that the *Body* fall obliquely upon the surface that separates both *Mediums*, that so it may be deflected or turn'd aside. For if it should proceed *Perpendicularly*, without any *Declination*, seeing it would not be hindred on the one side more than on the other, from proceeding in a straight line, it could not suffer any *Deflection*, and consequently must continue its right motion, as hath been said.

XIII. *Requisits to determin the quantities of Refractions.*

To Determine the *Quantity* of *Refractions*, we must attend to the particular constitution of *Bodies*, whether they do more or less resist the passage of *Bodies* moved. For suppose we that the *line* C B E separates two *Mediums*, the upper whereof is *Air* and the undermost *Water*, and that the Water doth as much again as *Air* resist the motion of the *Ball* A. Suppose we likewise that the *Ball* A, having past the *oblique line* A B in one moment, to meet with the *Point* B, there obliquely to enter the *Water*: And that neither the *Bigness*, *Weight*, or *Figure* of the *Ball* do hinder it from so doing; Yea, and that its motion in the *Air* hath been always equal, and that having lost the one half of its swiftness, by meeting with the *Water*, it loseth now no more throughout its whole Course, how deep soever it may enter the Water; because this is nothing to the purpose, since the *Deflection* happens only in the *Surface*, and the *Water*, which resists equally on all sides, can only make the *Ball* to spend a greater or less space of time in its motion, but cannot make it to deflect from the *Line*, which it had begun to move in.

Figure 14.

XIV. *How much the Motion of a Ball is retarded by entring the Water.*

These things being observed, that we may know what way the *Ball* A must take, we are to consider that tho' the motion of the *Ball*, be lookt upon as *simple*, this doth not hinder but that its Determination in the *line* A B, with respect to the *Surface* of the *Water*, is compounded of two other *motions*, the one whereof presseth it from A F to C E, and the other at the same time presseth it from the left A C, to the right F E, so that both these together lead it to the *Point* B, by the right *line* A B.

Moreover we are to observe, that of both these *Parts*, whereof we understand that this *Disposition* consists, the one only is changed by the *Surface* of the *Water*, viz. that which drives the *Ball* downwards, whereas that which pusheth the *Ball* towards the right hand continues still the same.

XV. *Where the variation is in the Body moved.*

Having therefore described the *Circle* A F D from its *Center* B, and having describ'd upon C B E three *Perpendicular Lines* A C, H B, F E, so as that the space between them F E and H B, is the double of that which is between H B and A C, we shall find this *Ball* will go on to the *Point* I: for seeing that the *Surface* of the *Water* C B E, doth exactly take away one half of its swiftness, it must take up a double proportion of the time in which it passeth from A to B, in passing from B to any point of the *Circumference* A F D. And seeing nothing is lost of the Disposition whereby it was carried towards the right hand, in the double proportion of that time, wherein it proceeded from the line A C to H B, it must go twice the length towards the same part, and consequently approach to some point of F E at the same Moment in which it draws near to some point of the *Circumference* of the *Circle* of A F D, which would be impossible if it did not advance to I.

XVI. *How must the Balls motion is fore-showed when it passeth through the Water.*

We are also to take notice that the more obliquely a *Ball* dasheth against the *Surface* of the *VVater*, the more it is turn'd aside by it; so that if it be directed to right *Angles*, as if it were struck from H to B, it proceeds in a right *line* without any *Declination* to G, as hath been said already. But if it be driven along by a right *line*, as A B is, and lie so obliquely on the *Surface* of the *VVater* C B E, that the drawn line F E, cannot intersect the line A D, then will it not penetrate the *VVater*, but will rebound from the *Surface* B into the *Air* towards F, after the very same manner as if it had lighted on the *Earth*. As we see in those Stones wherewith *Boys* make Drakes in the Water; and as *Bullets* which (according to the Relation of those who have been in Sea fights) being obliquely shot out of *Cannons* rebound from the *VVater*, and hit Men standing on the *Decks*.

XVII. *The more obliquely a Ball falls on the Water, the more is it deflected.*

CHAP. XX.

Of the Force of Acting and Resisting.

I. *The force of acting and resisting taken in a two-fold sense.*

THe force of acting and resisting may be understood two several ways, either *Metaphysically*, for the Faculty or *Power* which any thing hath to act or resist. And this is nothing else but a *Non-Repugnance* to act or resist. So he who saith that a *Needle* can *prick*, thereby means nothing else, but that *Pricking* may Coexist with a *Needle*. Or else it may be taken *Physically* for *Reaction*, as when any thing that is moved upwards, is driven down by some other *Cause*, and thus resistance is called *Positive*; as when two *Bodies* in motion, meeting together, beat back one another; as two *Bullets* or *Bowls* meeting together, by their contrary Determination. Or it is also precisely taken for the force it self of Resisting, as when a *House* resists the *Wind*, or a *Stone* the *Ball* that is cast against it. And this is commonly called *Negative* or *Formal*. And it is of these two that we enquire here, *viz.* to know wherein the force a *Body* has to act upon another, or to resist it, doth consist.

II. *Wherein the Power of Acting or Resisting doth consist.*

All the Power any *Body* hath to act upon another, and every Faculty, whether *Positive* or *Negative*, of any *Action*, consists in this alone, That according to the forementioned Law of Nature, *Every Body, as far as in it lies, continues in the same state wherein it is*, whether in *Rest* or in *Motion*; because every state of *Bodies* may be referr'd to one of these. So that those *Bodies* which are joyned together by *Rest*, have a power to hinder themselves from being separated, as well as those that are *separated*, have a Power to continue so; and they that are *moved*, have a Power to continue their *motion*, according to the same degree of Swiftness, and towards the same Coast: As that which Rests in any place, hath a force to abide there, and to preserve its *Rest*. And this is the only cause of the *motion* of *Things that are* cast or *thrown into the Air*; concerning which we have more reason to enquire how they come to cease from *motion*, than how they continue it so long as they do.

III. *This Force ariseth first from the Bigness of the Body.*

Now this *Force* may be attributed to several Particulars: As first, to the *Magnitude* of the *Body* in which it is found. For it cannot be questioned, but that a *Great Body* exceeds a Less in the faculty of Acting and Resisting, because in regard to the *Parts* of which it is compounded it hath more *Motion* and *Rest*; and seeing every *Body* hath a proportionate Affection answering it, therefore the *Quantity* of these must be answerable to the *bulk* of the *Body*. Hence is that common Saying amongst *Naturalists*, that *a thing of greater Quantity, hath the greater Virtue*: Which *Virtue* is to be esteemed according to the force of *Motion* that is in the whole *Body*, or its firm *adhering* and *abiding* in a place. Thus *Fire*, the more it is extended in *bulk*, the more violently it *burns*; and the more fixedly any *Bodies* continue in one place, with the greater difficulty are they thrust out of it. Thus *Round Bodies* are the strongest both in Action and Resistance, as appears in *Pestils*, *Millstones*, *Cylinders* or *Rowling-Stones*, and other such like *Instruments*, which are the more proper to bruise *Bodies*, and making them smooth or even, because their force is altogether directed to one Line. Thus also a *Hammer*, with a long Handle, strikes the *Anvil* with a greater force than that which hath a short one.

IV. *Secondly, from the Bigness of the Surface.*

The Power of *Acting* and *Resisting* is also taken from the largness of the *Surfaces* of *Bodies*; for the *broader* the *Surface* of two *Bodies* is, the more firmly do they cleave together; as appears in *two Wooden-boards*, *well plained*, lying upon one another: Whereas on the contrary, where the *Surfaces* are narrow or little, by so much the less firmly they stick together. Thus *Sphærical Bodies* less stick together, because their *Surface* is the least of all *Bodies* with respect to their *bulks*, and they touch each other only in a *Point*. And certain it is that *Lead* made up into a great *Bullet*, is more solid than that which is distended into a thin *Plate*, or made hollow. Wherefore the greater quantity of *Matter* is contained under a little *Surface*, the more *solid* it is, and of the *greater* efficacy to resist; as is evident in *Gold*, *Lead*, *Iron*, and other *Metals*, which being once put into *Motion*, retain a greater force to preserve and continue it, than either *Wood* or *Stones* of the same *bulk* or *figure*. But on the contrary, *Triangular Bodies*, and such as have more *Surface* than other *Bodies* proportionably to their Extension, are more difficultly *moved*, and have less force to continue the same, or to resist other *Bodies*.

V. *Thirdly, from the Swiftness of Motion.*

The said Faculty of *Acting* and *Resisting* may likewise be estimated, from the *swiftness* or *slowness* of *Motion*. For a little force resists *Bodies* that are swiftly moved; as when we lash the *Water* with a *Rod* or *Wand*, we find the *Water* to resist the *Rods* entrance. Because (as hath been hinted heretofore) the Strife of Material things in *Acting* and *Resisting*, depends on the determination of the *Motion* towards some certain *Part* or *Coast*, and its meeting with a *Body* resting there, or otherwise moved. And a *Body* is then taken to be otherwise moved, when it is either moved more slowly, or another way.

VI. *Fourthly, from the Meeting of Bodies.*

This *Force* may also be gathered from the nature and contrariety of the *Mode* or *Manner* whereby divers *Bodies* meet with one another. For according as they are variously oppos'd to each other, so they have a different force of *Acting* and *Resisting*. Thus a *Stone* slantingly thrown on the *Surface* of the *Water*, so as to leap from it, cannot divide the Top of the *Water*, as if it had been downright cast into it.

VII. *A threefold Difference is incident to Motion.*

From these Four Particulars, to which all *Action* and *Resistance* of *Bodies* may be referr'd, we may determine how *Bodies* do increase, or diminish their *Motions*, or change the determination of them, (for there is this threefold difference in *Motion*;) only we are to observe how much *Force* there is in every *Body*, either to move or resist *Motion*, and certainly conclude, that *that which is strongest, always takes effect*. Thus the *Motions* of Great *Bodies* have their Force from the *Agreement* of their *Parts*, though their *Motions* have but few degrees. So *Stones*, and even *large Buildings*, are oft forc'd to give way to a *River* that runs but slowly. And upon the same account, in other *Bodies* also the *motion* may be strong, tho' it be not swift: And on the contrary in less *Bodies*, there may be a considerable swiftness of *motion*, and not any great *force*. As if the *Body* A (for Example) should be moved as swiftly again as B, and the *Body* B should exceed A in bigness in a double Proportion, in this case we must estimate as much *Motion* to be in one, as in the other; because the Extrusion which is found in the *Greater Body*, is by its *bulk* equivalent to the Intension of *Motion* in the other.

VIII. *That which is strongest always obtains its effect.*

Now in the *opposition* or *meeting* of *Bodies*, this *Rule* always holds good; *Whatsoever exceeds another thing in strength, obtains its effect*, whether it be in moving another *Body*, or in resisting its *Action*. And therefore of those things that tend to the same place, if it be not large enough to contain them all, the strongest only do get thither, leaving the weaker behind them. Thus the most lively and vehemently moved *Particles* of the *Blood* are received into the Cavities of the *Brain*, the weaker being hindred by the stronger from arriving there; because the Passages of the *Brain* are too narrow, than that all the *Particles* of the *Blood* can get up thither.

CHAP.

CHAP. XXI.

Of the State of Bodies; *and first those that are Hard, Fluid, Frangible, Friable, Soft, Ductile, and such as may be cut or slit.*

I. *Whence the Hardness of Bodies proceeds.*

AMongst the *Principles* of *Natural things*, *MOTION* and *REST* only are opposed to each other, not *privatively* (as some would have it) but *contrariously*, as two *Modes* really distinct. For *Rest* or *Quiet* is not a *Privation* of *Motion*, but a true *Form*, whereby Stable and *Hard* Bodies are distinguish'd from such as are *Fluid*, and whence they receive the force of *Acting* and *Resisting*. For those Bodies are accounted *Hard*, whose *Parts* by a firm Union lye still together; or whose *Parts* do so closely cleave together, that they cannot without difficulty be separated. Which close Union is perceptible to the *Senses*; for if we touch any of these *Hard* Bodies with our *Hands*, or any other part of our Body, they resist them, and oppose their entrance; as we see in *Marble*, *Wood*, *Stone*, *&c.* for if, when they are handled by us, they give way, we should perceive no Sense of *Hardness* at all; as appears by the *Air*, which is not felt by us, because it gives way to our *touch*.

II. *What is the Cause of the variety of Hard Bodies.*

The *Hardness* of Bodies is various, according to the variety of *Rest*; for wheresoever there is more of *Rest*, there also is more of *Hardness*; and so contrarily. *Clay*, when the *Water* is evaporated from it, grows *hard*, because the *Rest* of its Parts is by this means increased, its *Earthy parts* being delivered from the *Agitation* of the *Fluid parts*, interpos'd between them; whereas *Wax* being heated, becomes *soft*, because the *Rest* of its Parts is lessened, by reason of the *Oily Particles*, which being benum'd before, are by the *Heat* put in motion.

III. *What Hardness is.*

When we say that *Rest* is the Cause of *Hardness*, we mean the *Formal*, not the *Efficient Cause*; for the *Efficient Cause* of *Hardness* consists only in the *force* wherewith the *Air*, or other *Subtil Matter*, compresseth the Parts of *Hard* Bodies. To the end therefore that we may have a distinct *Idea* of *Hardness*, we must conceive it to be nothing else, but *the Rest of many parts of* Bodies, *caused by the Pression of the Air, or the Subtil and Æthereal Matter, which acting from without, drives these parts inward in such a manner, that they cannot be separated afterwards, without making us sensible of their Resistance.*

IV. *What is the Cause of the Fluidity of Bodies.*

Fluid Bodies, on the contrary, readily yield to the *motion* of other Bodies, and therefore do not resist our *Hands* when we touch them, as appears in the *Water* and *Air*. The Cause of which difference consists only in *Rest* and *Motion*: For if we enquire why some Bodies cannot but by force be thrust out of their *places*; whereas others without any difficulty yield the *place* they are in possession of, to others, we shall find that the Reason is, because their *Parts*, which resist those Bodies that approach to them, lye still and *Rest*; whereas the *Parts* of other Bodies, that without any force do leave their *places*, are in *motion*. So that *Hard* Bodies are such, whose *Parts* lye still and cohere together; but *Fluid* Bodies are divided into many little *Parts*, which are variously moved. For the *Parts* of *Water*, or any other *Liquor*, are agitated every way by the Subtil and *Æthereal Substance*: And accordingly those Bodies are called *Fluid*, whose *insensible parts* have such various Motions.

V. *How it appears, that the Parts of Fluid Bodies are agitated every way.*

Now that the *Parts* of a *Fluid* Body are moved, and that equally *every way*, appears from hence, that in what part soever of a *Fluid* Body we do move our *Hand*, or a *Stick*, it always goes on with the same easiness, which could never be, if the Determination were stronger one way, than it is another. Tho' it cannot be deny'd, but that some Resistance is found in a *Fluid* Body, if we swiftly lash any thing against the *Parts* of it; because a Body slowly moved, comes under the Notion of a Body at rest, when compared with a Body that is much more swiftly moved, and consequently will resist it.

VI. *Fluid Bodies have no certain figure, as Hard Bodies have.*

Hence it is that the *Figure* of *Fluid* Bodies is undetermin'd, because they are so easily divided and diffus'd, that they cannot keep themselves in their own *bounds*. But *Hard* and *Stable* Bodies being hard to be divided, easily retain their *Figure*, and are easily comprehended within their own *limits*; as appears in *Lead*, *Iron*, *Silver*, *Gold*, *Wood*, *Marble*, *&c.* which according to their several degrees of *Solidity* preserve their *figure* and *Bulk*. That therefore we call a *Fluid* Body, whose Parts being divided into many small *Particles*, and these again into less Indefinitely, are variously agitated. But that is called a *Hard Body*, whose Parts by *Rest* do so closely cleave together, that they cannot be separated, but by a Force sufficient to overcome their coherence.

VII. *The various kinds of Fluid Bodies.*

The smaller and lighter the *Parts* of any *Fluid Body* are, the greater is its *Fluidity*; and the thicker and more Branchy they are (if Contact doth not hinder) so much the less is it. Hence arise the diverse kinds of *Fluid Bodies*, according as by the lightness and smalness of their *Particles*, they are more, or according to the Thickness and Branchiness of them, less yielding to the *Cœlestial Matter*, which is the Cause of their *Fluidity*. Upon this account it is that the *Air* is more *fluid* than the *Water*; because the *Parts* of *Water*, tho' they be smoother, yet are thicker than those of the *Air*. And *Water* is more *fluid* than *Oil*, because the Parts of *Oil* are more thick and branchy: Lastly, *Oils* are more or less *fluid*, as their *Particles* are more or less *thick* and *branchy*.

VIII. *How Fluid Bodies are said to be in Motion.*

When I say that the *Nature* of *Liquid Bodies* consists in *Motion*, it is not so to be taken, as if the whole *Liquid* Body were moved out of one place to another, for this happens also to *Hard* Bodies: For a *Bowl* of *Brass* is easily rowl'd from one end of a *Table* to the other, and for all that persists to be a *Hard Body*; but in this, that the *Particles* into which they are divided, are moved and variously agitated, some of them being tost *to the Right*, others *to the Left*; some *upwards*, others *downwards*; some *forwards*, and others *backwards*: Which *Motions* of the *Particles* must be different. For if they were all of them carried one way, they would in a short time cling together, and make up a *stable* or *hard* Body.

IX. *Why Ice is carried with a greater Force, than the Water.*

And tho' the Course of a *River* be directed to one particular part of the *Land*, it does not therefore lose the *Name* or *Nature* of a *Fluid* Body; forasmuch as the various Motion of the *Particles* of the *Water* is preserved, notwithstanding the said

said Course of the *River*, as much as in a still *Standing Water*. Hence it comes to pass, that *Ice* driving on the top of the *Water*, because of the firm clinging together of its *Parts*, doth with a greater force pursue its way, and with more violence set against the *Banks*, than the *Water* it self which carries it; because the *Parts* of *Water* being tost with various *Motions*, weaken the force of it, and therefore cannot tend with that vehemence to one part, as the *Ice*, which is a *solid* Body, doth. By which Example it is evident, why *Fluid* Bodies easily give way to other Bodies, but *solid* Bodies not; because *Fluid* Bodies are always in *Motion*, and therefore do not oppose the entring of other Bodies into the places they are in, but readily and easily quit them. Whereas *Hard* Bodies rest, and according to the *Law* of *Natures* immutability, strive to continue in the state of Conjunction, except they be disturbed by some strong *Motion*.

X. *How the Parts of Solid Bodies are joyned together.*

This Sentiment will not please some *Philosophers*, who suppose no two Bodies can be joyned without some intervening Third, distinct from them both; which they imagine to be as the *Glew* that holds the parts together, that the *Union* may be the more firm: But since nothing is to be admitted in *Natural Philosophy*, which we are not convinc'd of by *Reason*, we must consider first, what kind of *Glew* this can be, before we appropriate it to this use. Without doubt it must be either a *Substance*, or the *Mode* of a *Substance*, seeing that amongst *Natural things* nothing else is to be found besides *Substances* and their *Affections*. If it be supposed to be a *Substance*, it cannot be understood why the *Parts*, which because they are *Substances*, cannot be united by themselves, should yet stand in need of an adventitious *Substance* to unite them. If it be a *Mode*, then without doubt none can be more properly assign'd to this purpose than *Rest*, since that which makes the *Parts* to be united together, must be most opposed to *Motion*, by which they are divided from one another. For *opposit Things must have opposit Principles*; but nothing is more contrary to *Motion* than *Rest*, as being the contrary Affections of *Material Substances*.

XI. *The Motion of the Particles of Fluid Bodies, is discernible from their Effects.*

You'l say, *How may we know that the* Parts *of* Fluid Bodies *are in continual Motion?* I answer, That tho' the smalness of those *Particles* doth not permit us to discern their *Agitation*, yet may the same be easily discovered by the *Effects*. There is no body but perceives, that some parts of *Water*, evaporate in *boyling*, and that in the *Summer* time *Ponds* are lessen'd or dryed up, which could not be, but that some Parts of the *Water*, being separated from one another by *Motion*, steam away into the *Air*. Moreover, how else comes it to pass that the *Particles* of *Water*, do so readily mix together? Or, how could they insinuate themselves into the *Pores* of *thick* Bodies, if their Parts did cling together by mutual *Rest*?

XII. *The Motion of Parts causeth their Division.*

For the *Division* of *Parts* depends on their *Motion*, *Agitation* being that which separates one thing from another. This is very evident in *Flesh*, which is soon corrupted by the *Air*, the *Particles* whereof being agitated either by the *Sun*, or some other way, thrust themselves into the *Pores* of *Flesh*, and by dilating of them and spoiling their Natural situation, do at last dissolve and putrifie it. The ready and thorough mingling of *Liquors* discovers the same thing, it being evident that th s easie mingling cannot be done without *Motion*, whereby the Parts of two *Liquors*, as for Example, *Water* and *Wine*, run together.

XIII. *Bodies would not be distinguish'd from one another, if some were not moved.*

Besides, what *diversity* would there be amongst Bodies, if all their *Parts* lay still together, and were equally united? *Cold water* would not differ from *Ice*; *Crystal* and *Milk* would be the same thing; nor would any Cause be assignable, why *Crystal* resists our touch, or why *Milk* yields to the approach of *Hard* Bodies.

XIV. *Parts of a twofold sort are found in Liquid Bodies.*

Wherefore we may conceive twofold Parts in *Liquid* Bodies; some at it were *flying*, by reason of their swiftness, such as the Parts of *Smoak*, the *Steam of boyling Water*, and *Flame* are, which are tost so forceably that our Senses can discern their *motion*: And others, as it were, *creeping*, because of the slowness of their *motion*; as the *Particles* of *Oil*, *Milk* and *Wine*, whose *motion* is so slow and leisurely, that our *Senses* cannot perceive it. So that when it happens that one *Liquid* Body is not sufficient to dissolve another, or that it can exercise its force more upon one Body than another; the Reason thereof chiefly is, because its *Parts* are more or less agitated, or because the *Pores* of those Bodies are not open alike.

XV. *What Soft Bodies are,*

Soft Bodies approach to the Nature of *Liquid*, and are such whose *Particles* do not cling so close and firmly together, as the Parts of *Hard* Bodies, nor are agitated with so swift a *motion* as *Fluid Bodies*, but partake of both their *Natures*, being middle things between *fluid* and *stable* Bodies, such as are *Sand*, *Wax*, *&c.* The softness of *Sand* is caused, for that something intervenes betwixt their separated *Parts*: And *Wax* is soft, because its *Particles* terminate in flexible branches, which twisting together lightly, joyn the said Parts.

XVI. *Frangible, are reckon'd amongst Hard Bodies.*

Of *Hard* Bodies some are *Frangible*, others *Friable*. For whatsoever can be broken must have such a degree of stiffness, that its outward Parts when struck, may be neither dilated, nor admit any ingress of *parts* into *parts*; but that the *surfaces* being broken, the *inward parts* likewise be divided and broken asunder. Of which Nature are *Flints*, *Earthen Pots*, *Stones*, and the like, which according to the diversity of their contexture, are more easily or hardly broken.

XVII. *Friable Bodies.*

Thus *Friable* Bodies must have so much stiffness, that they cannot be stretched or bended; but upon any force pressing upon them, do crumble into *Dust*. Of which Nature is the *Sand-stone*, which is easily dissipated into small *parts*, and those again easily crumbled to *Dust*.

XVIII. *Ductil Bodies resort under Soft Bodies.*

Amongst *Soft Bodies* are reckoned those that are commonly called *Ductil* (that is, Bodies that suffer Drawing or Extension) such as *Gold* is, one *grain* whereof may be drawn into a *Thred* of four hundred Foot long; and consequently one *Ounce* to the length of 230400 Foot. The Cause of which vast discussion is commonly attributed to its extream *Compactness*, the *Thinness* of its Parts, and their intimate *Union* and *Connexion*. Of which we shall speak more at large hereafter.

XIX. *Bodies that may be cut or slit, belong to Soft Bodies.*

Some reckon *Bodies that may be cut* or *slit*, also amongst *Soft Bodies*; because whatsoever is cut, must have so much flexibility, that the Part which is prest (suppose with an *Ax*) can give way downwards, at the same time that the Collateral parts yield to the dividing *Instrument*. And whatsoever *can be slit*, must be so *flexible* or *bending*, that

that when the *Parts* in a certain place, begin to be pull'd asunder, a Compression may be successively made, in whatsoever places the rest are to be gradually separated from each other. *VVood* is said to be Cut, when it is divided *Cross-wise*; but to be slit, when divided *Long-ways*, or with the *Grain*.

CHAP. XXII.

What Loose and Close, Rough and Smooth, Contiguous and Continuous Bodies are.

I. *Whence proceeds the Loosness or Closeness of Bodies.*

AS *Stable* and *Fluid* Bodies are constituted as such by *Rest* and *Motion*; so *Loose* and *Close* Bodies are made such by their *Figure* and *Situation*, not *outward*, but *inward*. For the *Loosness* or *Closeness* of *Bodies*, is not to be considered according to the outward Space in which *Bodies* are dilated or contracted; seeing that a *Body*, whose Essence consists in three *Dimensions*, cannot take up a greater Space at one time, than at another; but according to the *Intervals* which are understood to be betwixt their *Parts*; and which are said to be *distended*, when they are fill'd with any foreign Matter; or to be *contracted*, when by Removal of that *Matter*, they are either lessened, or quite taken away.

II. *Loose Bodies are made such, by the Ingress of Matter; Close Bodies by the Egress.*

For we must not imagin, as many do, that the *parts* of *Loose* Bodies are so separated from one another, that nothing extended comes between them; For no such *Vacuum* can be in *Nature*; but that the said *Intervals* are fill'd with other *Bodies*; as is apparent in *New-bak'd Bread*, which being put into *Milk* or *VVine*, presently swells up into a much greater *bulk*; because the Pores of the *Bread* are distended by the intruding *particles* of the *VVine* or *Milk*. So that all the New Extension we find here, is not to be attributed to the *Substance* of the *Bread*, but to the *fluid* Body that hath insinuated it self into the *pores* of it. Which is evident not only to *Reason*, but to the *Senses* themselves: For if a man behold the *Steam* that riseth out of a Pot of *boyling VVater*, or the *Smoak* that proceeds from a *Torch* at a distance, he will suppose the *parts* of them to be contiguous; but when he comes nearer, and views them more wishly, he will find that there is neither *Continuity* nor *Contiguity* between the *parts* of them, but that they are separate from one another, by means of a foreign intervening *Matter* that divides them.

III. *Examples of Loose and Close Bodies.*

A *Body* becomes *close*, when the *parts* of it being nearer together, leave few *Intervals*, or none at all. Of the first sort are *Snow*, *Hay*, and *Wool*, when they are compress'd, as also a *Sponge*, when the Water is squeez'd out of it; for then by the expulsion of the *Liquor*, its *Pores* are narrowed, and few *Intervals* are left in it, to receive any outward *Bodies*. Of the latter sort are those *Bodies*, which have no *Pores* at all into which any *External Body* can enter; and when it is so close, then it cannot be further condensed by any *Power* of *Nature*.

IV. *What Rough and Smooth Bodies are.*

As with respect to the *Figure* and *Situation* of its *Inward parts*, a *Body* is distinguish'd into *Loose* and *Close*; so with regard to their *Outward figure* and *situation*, Bodies are said to be *Rough* or *Smooth*. Which *Modes* are of great efficacy in *Natural things*; as appears in a *Knife*, wherewith the *Hardest Bodies* are cut; and in a *Pen*, with which an infinite variety of *Characters* may be made.

Rough Bodies are such whose superficial *Parts* are unequally disposed, so as that some are prominent and others depress; as *Rusty Iron*. But *Smooth* or *Polish'd Bodies* are such, whose Extream parts are equally situated, as *Ice*, a *Whetstone*, &c. *Smooth Bodies*, because of their Surface, have more force to Act or Resist, than *Rough Bodies*. For a *Sword*, whose *Edge* and Extream parts are polish'd and even, cuts deeper than another *Sword* of the same bigness that is *Rusty*; and a *Ball* rebounds more strongly from *polish'd Bodies*, than from *rough*.

V. *All Bodies are not Smooth, which appear to be so.*

Yet we are not to imagin, that all those *Bodies* in which neither our *Touch* nor *Eyes* can discover any inequality, are altogether *smooth*; forasmuch as even *Glass* and *Crystal*, which appears very *smooth*, have a *rough Surface*. For tho' *Glass* be made of *Salts*, which by Melting are resolved into very small *Particles*; yet because those *Particles* still retain their former *figure*, they can never make a *polish'd Surface*. What appears to our *Eye* more smooth than *Paper*? And yet by the help of a *Magnifying-Glass*, we perceive it to be very rough and uneven. Hence it is manifest, that in what part soever of the *Medium* the *Eye* be placed, it receives the various *Rays*, which come from and represent the Object.

VI. *What a Contiguous and Continuous Body is.*

The two Remaining *Species* of *Bodies* are *Continuous* and *Contiguous*. A *Body* is said to be *Contiguous* with respect to the *situation* it hath amongst other ambient *Bodies*. Thus a *Tree* surrounded by the *Air*, is said to be *Contiguous* to it. And accordingly a *Contiguous Body* is thus defin'd by *Plato* in *Parmenides*: *That which is to touch something, plac'd by it self, must be next to that which is to be touched; neither is there any Third thing that is a Medium between both these.* A *Continuous Body* is that which besides the situation it keeps amongst *Circum-ambient Bodies*, becomes united to them, and by *Rest* is joyned with them. Thus a *Stone* is said to be a *Continuous Body*, being considered whole and undivided, and before any change happen to it by *Motion*. But this *Contiguity* of *Bodies* is not in all their *parts*, but only in those that are Insensible, since such only have an immediate *Contact* with one another.

VII. *Wherein the Nature of Contiguity and Continuity consists.*

The *Continuity* therefore of *Bodies* consists in this, that their *parts* do cleave together by an Immediate Connexion, and rest together. So that *Continuous Bodies* cannot be dissolved, but by such a *Motion* as prevails over the *Rest* of their *Parts*. The *Contiguity* of *Bodies* consists in this, that their *Extream parts* lying still together, nearly touch one another, yet so as that a most thin subtil *Matter* flows and runs between them; and by reason of this Interfluent Subtil Matter, the *parts* of *Contiguous Bodies* are more easily separable.

CHAP. XXIII.

That there are Pores in Hard Bodies, as well as in those that are Fluid and Soft.

I. *Supposing Bodies to be moved, it is nec*

THO' it is not denied, but that the *VVorld* was *Created* in the *Beginning* with all that Order and Beauty which we find it to have at present, and that all the *Bodies* contained in it had the same *perfection* which we see they now have;

G. Freman. fe. I. Kip Scul.

To ye Right Worshipfull
Brafferton hall in ye
Yorke shire Knight, &
Daughter & Cœheyre of
Yarington in Oxford
This Plate is humbly

S.r Samuel Gerard of
North Rideing of
to Elizabeth his Lady
S.r Thomas Spencer of
Shire Baronet
Dedicated by Richard Blome

little *Particles*, to the end it may be able to exert its *Force*, and to thrust it self into other *Bodies*. But yet we are not to imagin, that all the *Pores* of *Consistent Bodies*, have their *Pores* hollowed after the same manner, or disposed in the same *situation* and *figure*: For they who in *Winter time* put on a Wastcoat over their Shifts, find themselves less subject to *Cold*, than when they wore nothing besides their *Shirts*; which would not be so, if the *Pores* of the *Shirt* and *Wastcoat* did answer to one another in their *figure* and *situation*.

X. *How the Pores of Bodies come to be destroyed.* As *Pores* do arise by the *Generation* of *Bodies*, so by their *Dissolution* they are destroy'd. Thus the *Pores* are destroy'd in *Wood* that is *worm-eaten*, and in Clothes that are *Moth-eaten*. Or if the *Pores* be wider, as in *woollen Cloth*, and other such like, they may happen to be divided in the midst, and afterwards be made whole again by being joyn'd to other *Pores* of a like *figure*. Another way whereby *Pores* are destroyed, is that of *Obstruction*, when the *parts* of *Bodies* become so closely united, as to make one *Continuous Body*; as when by means of Condensation the *Pores* are lessened, or quite taken away; or when some supervening Matter remains in them, and hinders any other *Matter* from entring them: So when the *Pores* of the *Sails* of a *Ship* are fill'd with *VVater*, it hinders the *VVind* from passing through them, notwithstanding that the *VVind* have a far greater agitation than the *VVater*.

CHAP. XXIV.

Concerning Duration, and its Species, Time and Eternity.

I. *Duration agrees to all existing Beings, and is only notionally distinct from them.* FOrasmuch as *Natural things* exist, and take up certain places, it cannot be doubted, but that they are *Sometime*, and that they have *Duration* and *Continuance* in their Existing. For *Duration* is the Consequent of *Existence*; and whatsoever is not made, and destroyed in the same *moment*, must be considered as enduring, so that *Duration* may be defined, *An Attribute under which the Existence of Created things is conceived, in as much as they persevere in their Actuality.* From whence it is evident, that *Duration* is not really distinct from the *Existence* of a thing, there being only a Notional distinction between them. Because as there is no *Body* so little, but that it doth consist of parts, and may be measured with three *Dimensions*; so there is nothing in Nature of so short a *Duration*, but that we can measure it; neither can any thing be taken from its *Duration*, but as much must be taken from its *Existence*.

II. *The Definition of time* *Time* therefore is nothing else but *the Measure of the successive Duration of Bodies, according to the equal Motion of the greatest* Bodies, viz. *the Sun, Moon*, &c. *Aristotle* defines *Time* to be *the number of Motion, according to Former and Latter*. But this Definition stands in need of another to make it *Intelligible*, except by *the number of Motion according to Former and Latter*, he means only thus much, that by *Time* we number the successive *Duration* of *Bodies*, in which there is Former and Latter according to the *Motion* of the *Sun*.

III. *The three Differences of time.* There are commonly three Differences of *Time* reckoned, *viz. Past*, which hath already been; *Present*, that which now is; and *Future*, that which shall be. By the *Present time*, we are not to understand an Indivisible *Instant*; for no such can be found either in *Time* or *Motion*, the Nature of them both being successive; but all that part of *Time*, which the *Mind* represents to it self as Present: Thus we say, the Present *Hour, Day, Month, &c.*

IV. *Time is the Measure as well of Rest as of Motion.* From the foresaid *Definition* of *Time*, it is apparent, that *Time*, being the Measure of the successive *Duration* of *Bodies*, must Measure *Rest*, as well as *Motion*. For we say as commonly, that a thing hath *rested*, as that it hath *moved* so long. The same is manifest also from this Example, If a *Dog*, in half an hours time, run three Miles, and a *Tortoise* in the same time go only the length of one *Pace*; the Measure of the *Time* will be the same in both these *motions*, when yet there is much more *motion* in the *Dog*, than in the *Tortoise*. And therefore *Time* is nothing else, but the Duration of a Creature in whatsoever State it may be.

V. *Succession is included in every Duration.* For we find *Succession* in every *Created Being*, and we can Measure the same by *motion* properly so called, or at least by the thoughts of our *Mind*, which seeing they do not exist all at once, must needs involve Succession. Wherefore, neither can the *Duration* of an *Angel* or the *Mind of man*, be said to be altogether at once, as the *Duration* of *God* is, because we clearly understand succession, both in our own thoughts, and those of an *Angel*; for *Angels* do not think all things together and at once. But such a *Succession* cannot be admitted in the *Divine thoughts*, *God* being an *Act* altogether *Simple, Complete*, and liable to no *Vicissitude*. Wherefore also *Gods Eternity* is his very *Nature* and *Essence*, forasmuch as he is most sufficiently of himself. And so *Time* is the same with the *Created things* themselves, forasmuch as they receive their finite perfections successively, that is, the one before the other.

VI. *An objection taken from a thing that exists only one Moment* You'l say, suppose a *Creature* should only continue one *Moment*, that thing would exist in the *World*, but without any *Succession* of *Existence*; therefore *Succession* is not involved in the conception of *Duration*.

VII. *The answer that all Moments are divisible.* I answer, that *Duration* cannot be understood without *Continuation*, and therefore no part of *Duration* can be assigned so small, but that there must be continuance in it: Since no *Moment* can be conceived, which is not divisible into other *Moments*. Wherefore those are mistaken, that make the present *Time*, to be an Indivisible; for since every *Duration* is *Greater* or *Less*, that is, consists of more or less *Parts*, no real *Particle* of it can be assigned, which hath not a quantity of its *Duration* distinct from another. Wherefore as every *Particle* of a *Body*, may be divided into other *Parts*: So likewise the present Time is compounded of *Parts*, and is divisible into other Moments.

VIII. *Time is only an Entity of Reason.* Whence it follows, that *Time* is not an Affection of *Created things*, but a mere *Mode* of *Thinking*, or an *External Denomination*, which we call an *Entity of Reason*. For as *Things*, from the the *Operations* of our *Mind*, are said to be Known, Understood, Defined, *&c.* of which *Operations* they are only the *Objects*; so *Time*, whereby we Measure the *Existence* of *Created things*, is no more with regard to them, but an Extrinsecal Denomination, and a *Mode* of *Thinking*, made use of for the explaining of *Duration*. Hence *LUCRETIUS* saith Book I.

Time

Time of it self is nothing, but from Thought
Receives its Rise, by labouring Fancy wrought
From things consider'd, whilst we think on some
As Present, some as Past, or yet to come.
No thought can think on Time, that's still confest,
But thinks on things in Motion or at Rest:

GASSENDUS from these Verses of *LUCRETIUS*, concludes *EPICURUS* to have been of the Opinion of *ANTIPHANES*, who held, that *Time was something that had no real Existence, but only in the thought of Man.* which *ARISTOTLE* also seems to insinuate, whilst he defines *Time* by *Number*, which cannot exist without the understanding of the Counter or Numerator. *It is not in vain*, saith *GASSENDUS*, *that* EPICURUS *warns us, that we are to speak otherwise of Time, than of other things, which are in a Subject; thereby intimating to us, that time is in a Subject only by the help of our thoughts; forasmuch as the Mind of Man considers a thing not to cease to be, at the same moment it begins to be, but to abide and continue, and to keep its Existence for a longer or shorter space of time.* So that that it is evident that *EPICURUS* would not have any thing further to be inquired of *Time*; than what the Mind at first sight conceives of it, that is, a stay or continuance, whether it be longer or shorter. And if any Man should demand what *Time* is, we may answer him with *DEMOCRITUS*, that *Time is just such a thing, as is the space of Day and Night.*

IX. *What Duration is called Time.*

Wherefore to the end we may Measure the *Duration* of all things, we compare it with the *Duration* of some particular *Beings*, which have a certain and most equal *Motion*, by which *Days* and *Years* are made, and this *Duration* we call *Time*. Wherefore they who suppose the *Sun* to be whirld about the *Earth*, or the *Earth* to turn round about its own *Axis*, attribute *time* to the *motion* of either of them, as being its proper Measure, according to *Former* and *Latter*: But as for the *Duration* of other things, they will have them to be measured by *time*, only by means of an external Application of our *Mind*. Thus when we say, that *Nestor* lived 300 years, we mean that he lived so long, as that Motion lasted, wherein the *Sun* performed 300 of its yearly Courses, or the *Earth* 1095 Circuits about its own *Axis*.

X. *How time is said to flow, or to be successive*

If any one urge, that that there are many things agreeing to *time*, which cannot be attributed to an *Entity* of *Reason* or an *Extrinsecal Denomination*, as when we say, that *Time flies, Time teacheth Men many things*, that *Time comes, follows, &c.* which cannot be spoke of a thing that doth not exist at all, but only depends on our thoughts.

XI. *Answer.*

I answer, that these are *Metaphorical Speeches*, and which agree only to the things that pass away, are taught, come, follow, &c. For Time is said to *run*, or pass away, when things by an outward Application of our *Mind*, with respect to the *motion* of the greatest *Bodies*, which can be observed by all Men, are understood to exist for some time. *Time* is said to *teach* all things, when those things which heretofore where hidden from Men come to be known; and upon the same account Time is said *to come, to succeed, to vanish, &c.*

XII. *Whether upon the ceasing of the Motion of the great Heavenly Bodies time ceaseth also.*

If any Man should infer from hence, that therefore upon the ceasing of this universal and equal *motion*, of the *Sun* or *Earth*; Time must cease also, and be no more, because then our *Mind* will be no longer able to compare the *Duration* of *Created things*, with the *Duration* of certain equal and stable *motions*.

XIII. *Answer.*

To this I answer, by denying the Consequence, because *Former* and *Latter* is not only in *motion*, but also in our *Thinking Mind*, since that in it we find a true succession of *Thoughts*; for we cannot at once and altogether *Think* of all *things*, we can think of. And therefore, tho' all *motion* should be taken out of the *World*, yet would not that put an end to succession, but *Created things* existing in our *Thoughts*, would be still commensurate to *Former* and *Latter*.

XIV. *What Eternity is.*

Having thus explained the Nature of *Time*, it remains that we speak a few words of the other species of *Duration*, viz. *Eternity*, which they call the *Duration* of a *thing*, without either *Beginning* or *End*, and which belongs to *God* alone. And which *BOETHIUS* defines to be, *The All at once, and perfect Possession of an Interminable Life.* The word *Life*, is here taken for the existence of a *thing*, endued with all the *Perfections* it is capable of. The words *all at once* intimate, that *Perfection* does not agree to the *Eternal Being* successively, but that he possesseth them all at the same time. Whence we may infer, that no Creatures, whether *Material* or *Incorporeal*, could ever be *Eternal*, because it implies a contradiction for them to possess at once all the *Perfections*, *Qualities* and *Modes* which they are capable of.

XV. *All Beings are either Permanent or Successive.*

From all that hath been said it appears, that there are some things whose *Essential Parts*, can exist together, or all at once; and that there are others to whom this cannot agree. The better to distinguish these, I call those things successive, whose *Essential Parts* are in a continual Flowing. Thus *Time* is a successive *Being*, because *Present*, *Past* and *to come*, which are the *Essential parts* of it, are never all at once. And I call those *Permanent*, all whose *Essential parts* are together. Thus a *Triangle* is a *Permanent Being*, because the Content and the three *Sides*, of which it is composed, do exist all at once, or at the same time.

CHAP. XXV.

The Ends of GOD *are not to be enquired after in Natural Philosophy.*

I. *It is a piece of Rashness to enquire concerning the ends of God.*

THO we own GOD to be the *Efficient Cause* of all *things*, and that all *Creatures* depend on him alone, yet we have no mind to enquire, for what end they were produced by *God*, and what *Reasons* he propounded to himself, in calling them out of the *Abyss* of *Nothing*. Who knows not that the *Secrets* of *God* are unsearchable, and past finding out? And as it is not the part of an *Earthen Vessel*, to dispute the Point with the *Potter*, why he hath made him such; so neither does it become *Mortal Man*, to question with his *Maker*, why he hath done so and so. And indeed this *Reason* alone taken from the *Divine Majesty*, and our Littleness and Meanness, may be sufficient to restrain us, from enquiring into the *Ends God* hath proposed to himself in the making of *Natural things*.

For

II. *Our Human Infirmity ought to restrain us from enquiring into the Divine Secrets.*

For tho' in the Contemplation of *Natural things*, it be permitted to us to enquire, from what *Principle* they proceed, what their *Matter* is, and with what *Forms* they are perfected; yet is it a piece of Rashness and Arrogance in us, to dive into *Gods Counsels*: Whereas we ought rather to consider that we are weak *Creatures*, of limited *Perfections*, and not fully Masters of our own *Actions*; whereas *God* on the other hand is *Immense*, *Infinite*, *All-wise* and *Omnipotent*, so as to be able to produce innumerable *things*, the *Reason* whereof could never enter into our *Thoughts*.

III. *The things which are done in the Earth are not known.*

For if we are not able to give an account, of what use those *things* are to us, which in such great abundance are hid in our *Earth*, and cannot assert but that they have been destinated by their Author, to ends altogether unknown to us: How then shall we dare to pry into the *Arcana* of our most *Good*, most *Powerful* and most *Glorious Creator*? As if we were familiarly acquainted with his *Mind*, and as if we had been his *Privy Counsellours*. Is it not much better for us to adore his *Goodness*, without determining of those *things*, which it is not allowed Man to *know*, nor permitted to *search* into.

IV. *The Divine ends in Moral things may be searched after, but not in Natural things.*

I own that in *Moral things*, where Conjectures are of more Authority, it may be conducive to *Piety*, to enquire into, and determine the end *God* hath proposed to himself in *Creating* the *World*. Therefore *Preachers* to excite the *Divine Love* in us, set before our Eyes the several uses and advantages, which the *Creatures* afford us, telling us that they were made for our *Sakes*. But in *Natural Philosophy*, where nothing is to be admitted, which is not built upon the most unshaken *Reasons* and *Arguments*, it seems to be a foolish thing to guess at any *end*, that *God* should have proposed to himself, in the *Creation* of the *World*.

V. *Objection, that all things were made for Mans sake.*

But some will tell us, that according to the *Scripture*, all things were made for our *Sake*, because they are of some use to us. And therefore say, that the *Sun* was *Created* to give us *Light*; that the *Soul* of Man was made by *God*, to Contemplate him; yea, that the whole *Universe* was *Created* for *Mans Sake*, seeing that all *Creatures*, are some way or other serviceable to him: And that Consequently *Gods ends* may be known by us, as well as any other *Causes*.

VI. *The First Answer.*

To this may be answered, *First*, That true indeed it is, that the six days of the *Creation* are so described in *Genesis*, as that Man seems to be the chief end of them: But it may be said, that this *History* of *Genesis*, was penn'd for *Man's Sake*, and that therefore the *Holy Spirit* was pleased chiefly to set down those particulars which have reference to *Man*.

VII. *The Second Answer.*

I answer *Secondly*, That it doth not appear at all, that all things were Created for the Sake of Men. For how do we know, *what* and *how many things*, *God* hath made besides this *Earth* which we Inhabit, in the *Stars* and elsewhere? How do we know, but that there may be other *Creatures*, specifically distinct from any of those which we see, other *Animals*, other Men, or at least *Creatures Analogous* to Men, in some other places? These things are unknown to us poor Mortals, because the *Divine ends* and *Counsels* are hid from us. When it is said therefore, that all things are *Created* for *Man's Sake*, we are not so to understand this, as if *they* had no other use, save what they render to *Mankind*; but only this, that Man can and must *exercise* his *Wit* and *Understanding* about them. Now it is a quite different thing to say, that Man was *Created*, that he might *Celebrate* and *praise God* for the excellence of his *Works*; and to assert that all these *things* were *Created* for *Mans sake* alone. For in the former, *Mans Duty* is intimated, but in the latter, the end and aim of the *Creator* in making the *World* is determined.

VII. *It seems a great piece of Rashness to assert that all things were created for Man's sake.*

Besides, it is an absurd thing to imagin, the *Sun* to have been *Created* for no other end, save only to enlighten us: And that the *Stars* and *Plantes* were ranged in their several *Vortices*, only to assist and pleasure us; since we are the very least part of the *Earth*, and the very *Earth* it self (in respect of the *Heavens*) is no more than a small *Grain of Sand*, compared with a *Mountain*. Wherefore let us take heed of entertaining such presumptuous Thoughts of our *selves*, as if all things were made for our *use*, *profit* and *advantage* only; when there may be an infinite number of *Creatures*, that by many degrees exceed us, whose Nature and Excellence is altogether hid from us. Have not we much more reason to have such *thoughts* as these, than to entertain those other presumptions, when we consider the immense *Power* and *Widom* of our *Infinite Creator*?

IX. *The Glory of God was not the Reason why the World was created.*

Some, pretending Zeal for the Honour of *God*, tell us, that his own *Glory* was the end and aim he proposed to himself, in the *Creation* of this *Universe*; as if *Gods* aim in the Production of this *World*, had been only to display his *Magnificence*, and to exalt his own *Glory*. But who can believe this? Shall we say, that *God* could not have provided for his own *Glory*, by other things different from these? Would his *Honour* have been ever the less, if he had *Created* another *World*? You must then own, that his *Glory* was not the sole motive he proposed to himself in creating of the *World*. Moreover, how can it be said, that *Glory* was the *Creators end*, seeing it is a thing extraneous to him, and which doth not at all belong to his *Essence*? For *God* can never be said to be determin'd in his *Actions*, by any thing that is without him, neither can any *thing* that is without him, be a motive to him.

The Fifth Part
OF THE
INSTITUTION
OF
PHILOSOPHY.
VIZ.
SPECIAL
Natural Philosophy,
CONCERNING THE
WORLD
AND
HEAVEN.

CHAP. I.

Of the Unity and Perfection of the World.

I. *What is meant by* Special Physicks.

HAving examin'd those things that belong to GENERAL PHYSICKS, and thereby consider'd a *Body* or *Matter* in *General*; that is, its *Nature, Principles, General Affections* and *Differences*; we proceed now to SPECIAL PHYSICKS, or that Part of *Natural Philosophy* which takes a view of *Matter*, as distinguish'd into *Species*, and lays open their several *Species, Properties, Distinctions*, and *Mutations*, in a more particular manner.

II. *The Species of Bodies may be considered two ways.*

Now the *Species* of *Bodies* may be consider'd after a twofold manner, *viz.* either *Jointly* or *Separately*; or, as others express it, *Collectively* or *Distributively*. The *Species* of Bodies are *Collectively* consider'd, when they are view'd all together, as the Parts that constitute one Whole or Entire *Being*. *Distributively*, when the chiefest *Species* of *Bodies* that compose the *World*, are in a convenient Order particularly examined.

III. *The Definition of the* World.

The whole which contains all the *Species* of Bodies, is called the *World*; and is the Comprehension of all *Natural* Bodies Created of GOD, and for GOD, by the most free *Motion* of his *Will* most beautifully *Adorned*, and most wisely *Governed*, and powerfully *Preserved*. And is thus defin'd by ARISTOTLE; *The Structure of Heaven and Earth, and of the several Natures comprehended in them.* Lib. *de Mund.* Cap. 2.

IV. *The World contains all things.*

For the WORLD comprehends all and every thing that can fall under our *Thought*. Whatsoever *Rhetorick* commends, or *Philosophy* admires, is a part of it. And therefore the *Ancients* have told us, That the *World* consists not only of *Animals* and *Men*, but of *Gods* also; and that accordingly the *World* is a *Kingdom* or *Commonwealth*, compos'd of the *Gods*, *Men*, and *Animals*: Which Saying of theirs is true enough, save only in that it imparts the Name of *God* to many, which is due to none but One alone.

V. *There is but One World, and no more.*

The WORLD is but *One only*, neither can a Plurality of *Worlds* be conceived without a Contradiction; for there can be no more than one *Universal* comprehension of Bodies, seeing that many *Worlds* cannot be conceived without *Distance*, neither can *Distance* be without *Extension*, nor that without a Body, which mediating Body would then joyn both *Worlds* together; for the conjunction of the *Parts* of the *VVorld* consists in nothing else but this, that all the Bodies in it touch one another. But to imagin two *VVorlds* separated by a *Vacuum* or *Imaginary Space*, that is, two

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I. Kip. Sculp.

two *Bodies* diſtanced from each other by Nothing, is meer Folly; becauſe to this diſtance by Nothing would belong *Extenſion*, *Diviſibility*, and *Menſurability*, and it might be either nearer or farther off.

VI. *Plurality of Worlds implies a Contradiction.*

However, if any one ſhould queſtion, whether there may not be another *VVorld* diſtinct from this. My Anſwer in ſhort is, that they who hold a Plurality of *VVorlds* not to imply a Contradiction, ſay, that ſuppoſing there were a *VVorld* diſtinct from this we live in, it might be placed in that Space which we imagine to be beyond the utmoſt *Heavenly Sphere*; but it is impoſſible that any *Bodies* ſhould be there, ſeeing it is ſuppoſed to be *Nothing*, or ſomething *Imaginary* only, and which conſequently can have neither *Parts* nor *Effects*, and therefore cannot place any thing. For *Place* being nothing elſe, according to *Ariſtotle*, but *the Surface of the ambient* Body, how ſhall we find a place there, where no *Bodies*, nor *Surfaces* are to be found?

VII. *Many Worlds cannot be united together.*

Moreover, if beyond the *higheſt Heaven*, there ſhould be another *VVorld* like to this, either they would touch one another, or be ſeparate. If we ſuppoſe them ſeparate, there muſt be ſome *Medium* that may wholly ſurround them both, and ſo neither of theſe *VVorlds* would be utmoſt, as having ſtill ſomething beyond them; and if they touched one another, being *Round Bodies*, there muſt be a *Vacuum* left between thoſe parts, that did not touch; but we have proved a *Vacuum* to be an Impoſſibility in *Nature*, in our *General Phyſiology*. Beſides, the *Space* which we imagine to be betwixt theſe two *VVorlds*, is not a meer *Nothing*, but a *Body*, ſince nothing but a *Body* can make a *Diſtance* betwixt two *Bodies*: For we cannot conceive one thing to be diſtant from another, without ſome real *Medium* that ſeparates them, which ſeeing it can be nothing elſe but a *Body*, it will joyn both *VVorlds* together, and ſo inſtead of ſeparating theſe two *VVorlds*, it will unite and make but one of them.

VIII. *Whatſoever we imagin to be Extended, is a Body.*

But to put an end to this Diſpute, we ſay that this *VVorld* hath no Bounds of its *Magnitude*. For ſeeing every *Space* is ſomething extended, and that no *Extenſion* can be without a *Body*, we conclude that nothing can be conceived by us beyond the *Heavens*, but what muſt be Real; and conſequently that there can be no other *VVorld* beſides this. And yet it cannot be inferr'd hence, that the *VVorld* is *Infinite*, but only that it is *Indefinitely Extended*, becauſe we cannot conceive ſo great an Extenſion in the *VVorld*, but we may ſtill imagine Greater, foraſmuch as all imaginable *Spaces* are fill'd with *Matter*.

IX. *The World is not Infinite, but Indefinitely extended.*

You'l ſay, If the *VVorld* be *Indefinite*, thas is, if we can imagine no *Bounds* or *Ends* of its Extenſion, it muſt be *Infinite*, becauſe *Infinite* is nothing elſe, but that which hath no *End*.

X. *The firſt Anſwer.*

I anſwer, *Firſt*, All grant that there are *Indefinite Parts* in every *Body*, ſo that it is impoſſible to come to the laſt of them; and yet no body ever aſſerted, that therefore a *Body* was *Infinite*. So tho' we admit an *Extenſion* in the *World*, the end whereof we cannot imagine, yet is not the *World* therefore to be reputed *Infinite*. For I do not ſee how that which hath *Finite Parts* can be accounted *Infinite*; nor how any *Maſs* or *Bulk*, which *GOD* can take ſomething away from when he pleaſeth, can be called *Interminate*.

XI. *The ſecond Anſwer.*

I anſwer, *Secondly*, that there is a great difference betwixt that which is *Infinite*, and a thing *Indefinite*; for we cannot aſſert any thing to be *Infinite*, except we have a Reaſon whereby we can demonſtrate it is ſo: Whereas to aſſert any thing to be *Indefinite*, it is ſufficient, if we have no Argument which proves it to be *Finite*. Which cannot be proved of the *World*; for it cannot be underſtood, that the *Matter* of which the *World* is made ſhould have any *Bounds*, ſeeing that whatſoever we imagine beyond the *Heavens*, we ſtill conceive it as an extended *Space*, which hath Length, Breadth and Depth, which conſtitute a *Body*. Of which we ſhall ſpeak more fully in the *Third Chapter*.

XII. *The World is Perfect.*

We cannot doubt of the Perfection of the *World*, if we conſider either the *Author* of it, who is *Infinite*, *All-wiſe*, *All-powerful*, *&c.* or the *Harmony* of the *Parts* of the *World*, the *Diſtinction* of *Natures*, and *Difference* of *Bodies* that are in it; becauſe we meet with nothing in it which is not Compleat and Perfect.

XIII. *The Imperfection of Parts, takes not away the Perfection of the whole.*

And tho' the *World* doth not conſiſt of things that are all beſt in their kind; becauſe all particular things that are in the *VVorld*, if conſidered in themſelves, cannot be ſaid to be *Perfect*, but only with reference to the whole *VVorld*, whoſe *parts* they are. For all things that concur to the conſtituting of any thing, muſt not be of one and the ſame Order. What would become of a Republick, if all the *Members* of it were *Senators*? What would the *Body* of *Man* be, if it were made of nothing but *Eyes*? What would *Muſick* be without *Diſcords*? So likewiſe the *Beauty* of the *VVorld* conſiſts in the *Diverſity* of *Kinds* that are in it; and things *Imperfect*, as well as *Perfect*, contribute to its orderly and moſt excellent Conſtitution.

XIV. *The Harmony of the World conſiſts in its Variety.*

Wherefore this admirable Structure of the *VVorld* would want much of its *Beauty*, without that Viciſſitude and Inconſtancy which we find in it. Hence it is that all things made by *GOD* are ſubject to *Corruption*, neither is any *Body* ſo firm, which in continuance of Time is not changed. Thus it hath been obſerved of late, that *VVorms* are generated not only in *Stone*, but alſo in *Glaſs*; ſo that we may well conclude, that there are no *Bodies* in the *VVorld* that are altogether exempt from *Corruption*.

XV. *It is no Argument againſt the Perfection of the World, that ſome hurtful things are found in it.*

But you'l ſay, Why are there ſo many Excrements of the *Earth*, *Air*, *&c.* in the *World*? Why were *Worms*, *Flies*, *Serpents*, *&c.* Created? ſince theſe frequently are miſchievous; and other *Creatures* again periſh, without having been of any uſe at all? I anſwer, that none of theſe things are *Superfluous* in the *World*, ſeeing that they are Inſtances of the *Power* of *GOD*, and if *Men*'s Induſtry be not wanting, may be employ'd to many good uſes. The very *Poiſon* of *Venemous Creatures*, by preparation and due exhibition, become great *Antidotes*; neither is there any thing ſo deformed in the *World*, which doth not add to its *luſtre* and *beauty*, as *Shadows* ſet off a *Picture*.

CHAP.

CHAP. II.

The Creation of the World proved by Natural Reaſon.

I. *Ariſtotle ſuppoſed the World to be Eternal.*

THE Authority of *ARISTOTLE* hath of a long time been ſo prevalent in the *World*, that it hath been lookt upon (and is ſo ſtill by ſome) as a great Error to depart from his *Opinions*: Which is more particularly evident in the matter beore us; For he ſuppoſed the *World* to have been from Eternity, and could not conceive how it could be produced, ſeeing that between *Entity* and *Non-Entity* there was an *Infinite Diſtance*. Some of his *Followers* have aſſerted the ſame thing, grounding their Opinion on their *Maſter's Foundation*, that *out of nothing, nothing can be made*, and that it was a plain contradiction, to ſuppoſe any thing to be made, but from *Præexiſtent matter*. Wherefore to overthrow this Opinion, ſo derogatory to the *Glory* of the *Creator*, I ſhall prove that *Creation* is *Naturally Demonſtrable*, and that it may eaſily be proved, that all things proceeded from *God*.

II. *What Creation is.*

By *Creation* we underſtand, that *Action whereby God immediately produceth any thing*. And that he hath in this manner produced all *Subſtances*, I prove thus.

III. *Everything that exiſts muſt have a Cauſe aſſigned it.*

There is nothing in the *Univerſe*, whereof we may not enquire whence it *Exiſts*; or what is the *cauſe* of its *Nature*, and the efficient of its *Exiſtence*. And this may not only be enquired concerning things *Created*, but likewiſe of *God* himſelf; who tho' he be *Independent*, *Infinite* and *Omnipotent*, yet it may be ſaid, that his *Immenſity* is the cauſe or *formal Reaſon*, why he needs no cauſe for his *Exiſtence*. But foraſmuch, as nothing like this is found in all other things, but rather the greateſt Limitation and Infirmity, we muſt conclude, that they never proceeded from themſelves, but from an *outward Principle*, and that they derive their whole *Eſſence* and *Exiſtence* from another. For it is moſt evident, that *nothing* (if I may ſpeak ſo amongſt *Philoſophers*) preceded their *Natures*, and that they came to be, by the Goodwill of the *Creator*, which is to be *Created*, and to proceed without dependence upon any other Cauſe whatſoever.

IV. *Since the World cannot preſerve it ſelf, it did not make it ſelf.*

The ſame may be proved from the *Preſervation* of all *things*: For it cannot be conceived, how a thing that cannot preſerve it ſelf, ſhould proceed from it ſelf; for if a thing be ſuppoſed ſufficient to afford it ſelf a *Being*, we cannot but conclude, that it would beſtow upon it ſelf, all thoſe *Perfections* it hath any *Idea* of; and ſeeing Conſervation is one of theſe, neither would he deny it ſelf this. For it is the ſenſe of *Philoſophers*, that *Conſervation* differs only notionally from *Creation*; and that it is the work of the ſame *Agent*, to produce an effect at firſt, and to preſerve it by a continual influx. Now it is evident by Experience, that no *Created things* can preſerve themſelves, therefore neither can they produce or *Create* themſelves.

V. *The parts of Time do not depend on themſelves.*

This will appear more clearly if we divide *Time*, by ſeparating the ſeveral *moments* of it from each other: For it is evident, that there is no *Union* between them, and that each ſingle part of it, hath no dependance at all upon the reſt. For it doth not follow, that becauſe I was the laſt *year*, therefore I ſhall be the next *year*, ſeeing that I may *die*, in the very moment that I am writing this. Conclude we therefore that that *Being* cannot produce it ſelf, which cannot preſerve it ſelf; ſeeing that *Conſervation* is nothing elſe, but a kind of continued *Production*, which is only by our Underſtanding diſtinct from *Creation*.

VI. *If the World had not been made, it would be God.*

All this *Diſcourſe* is very accommodate to our way of conceiving. For if it be true, that that *Exiſts*, which we underſtand to be without its Cauſes; then that alſo will be *poſſible*, which is clearly and diſtinctly known by us to be ſuch: But we clearly and diſtinctly perceive, that it is poſſible for the *World* to have been *Created*; therefore we muſt conclude, that it was actually *Created*, ſince nothing is found in the *Univerſe*, which is not dependent. For if *Independence* did belong to the *Sun*, for Example, or the *Earth*, the *Sun* and the *Earth* would be *God*, becauſe *Independence* cannot be without *Infinity* and *Omnipotence*. Whence it follows, that either *Creation* muſt be admitted, or we muſt expoſe our ſelves to one of theſe two Abſurdities; either that there is ſomething in the *World*, that had no *Maker*; or that in the ſubordination of *Cauſes*, there may be a proceſſion to *Infinity*, both which are inconſiſtent with Reaſon. It is abſurd to admit any thing in *Nature*, which was neither of it ſelf, nor produced by another. For whatſoever the *Mind* of *Man* can conceive, is either of it ſelf, and then it is *God*, ſince in the Conception of *God* all manner of Independence is included: Or is *from another*; and of that other we muſt enquire again, whether it be of *another*, or of *nothing*; if it be ſaid from another, we muſt further enquire of that other, until at laſt we come to that one *Principle*, which hath brought forth all things.

VII. *Things are not ſo connexed as to have no dependence upon the firſt principle.*

For we are not to imagin with ſome *Atheiſts*, that the *Creatures* are joynd together like *Links* in a *Chain*, which tho' they be all linked together, yet is there no neceſſity that the *Chain* made by them, ſhould be united to another *Chain*; becauſe the parts of a *Chain* are not produced of themſelves; but only keep ſome order amongſt themſelves. Now it is not in the leaſt contradictory, that two diſtinct *things* ſhould be united together. We know that all things *produced*, are cauſed by another, and that therefore it is neceſſary, that one thing as to its *Exiſtence* ſhould be before another; for the *Effect* is after its *Cauſe*, as receiving its *Being* from it. And thus of neceſſity we muſt at laſt come to one *Primary Cauſe*, which produced thoſe *effects*, or elſe muſt proceed to *Infinity*, which is the greateſt abſurdity in *Philoſophy*, ſeeing that nothing is more evident than that a Determinate *effect*, muſt come from a Determinate *Cauſe*: But how can this be, if we can never come to the *Firſt Efficient Cauſe*, but ſtill a further cauſe may be aſſigned, from whence the effect proceeds? Wherefore we muſt conclude, that there is ſome *Determinate Cauſe*, from which all other things flow and are produced.

VIII. *The Philoſophers owned the Creation.*

This *Truth* was owned by the Antient *Philoſophers*, who clearly perceived that the *Mind* of *Man* and *Intelligences* in their Production, did not depend on any *Præexiſtent matter*, as being altogether different in their *Nature* from it.

Moreover,

IX. *It implies a Contradiction that there are more Independent Beings than one.*

Moreover, who sees not that it implies a contradiction, that there should be more than one *Being of and from it self*, that is, *Infinite, Omnipotent, Immense, &c.* For whatsoever *Being* is of it self, must include all *Perfections*; and consequently, if all the things we see in the *World*, were their own *Makers*, there will be so many *Infinite Beings*, as we conceive that there are *Independent things*: Which is contrary to the order of things, and to the *Light* of *Nature*. Wherefore *ARISTOTLE attributes* to his *Heaven*, Immutability, the highest *Perfection*, and *Divinity* it self: As is evident to him that reads his Book, *de Cœlo. cap.* 2. & 6. *Ethic. cap.* 7.

X. *Many matters of Faith may be manifest by natural Reason.*

Neither doth it thwart what hath been said, that the *Creation* of the *World* is one of the *Articles* of our *Faith*: For *Faith* is not contradictory to *Reason*; yea, we may search out many *things* by *Reason*, which we embrace with a *Firm Faith*, from the *Divine Revelation*.

XI. *Three sorts of Questions.*

And that we may the better distinguish these Points, from those things which are *matter* of *Faith* only, we are to observe that there are three general *Heads* of *Questions*: Some are such as we first assent to by *Faith* only, such are the *Mysteries of the Trinity* and *Incarnation*. Other *Questions* are such, which tho' they belong to *Faith*, yet may be searched out by *Reason*, as *the Unity of God, the Creation of the World, the Existence of God, and the Immortality of the Soul Man*. And the last sort of *Questions* are such, as do not at all belong to *Faith*, but *Human Reason*: Such as are about *Gold* to be made by the *Art* of *Chymistry*, the *Squaring of a Circle*, and such like. As to the first sort of *Questions*, tho' they exceed the *reach* of *Mans understanding*, yet we are to believe them to be most true, because revealed to us by the *Holy Ghost*: Such points as these are indeed above *Reason*, tho' not contrary to it. Concerning the middle sort of these *Questions*, *Philosophers* may enquire, and shew that they are so far from being contrary to Reason, that they may be found out, cleared, and confirmed by it. As appears in this *Question* of the *Creation* of the *World*, in the handling whereof, I think, I have made it evident that the *World* could have no other *Original* but that of *Creation*.

XII *Whether the World could have been sooner Created than it was.*

Some curious person may enquire, why the *World* was Created just *at such a time*, and neither sooner nor later?

I answer in the *First* place, that before the *Creation* of the *World* there was no *Time*: For seeing *Time* is the measure of successive *Duration*, I do not see how possibly it could have any *Being*, before the Existence of changeable *things*. And therefore St. *Austin Lib.* 5. *de Genes ad Litt. cap.* 5. saith, *It is in vain to look for Time before the Creation, as if Time could be before the Creature was. For if there was no motion of any Spiritual or Bodily Creature, by means whereof future things might succeed to things that are Past, by the present, there would be no Time at all; nor could the Creature be moved before it was. Wherefore Time rather had its Beginning from the Creature, than the Creature from Time, and both of them from God.* Therefore to speak exactly, the *World* did not begin to be in *Time*, but had its *Beginning* with *Time*: And consequently, they speak very improperly, who say, the *World* might have been *sooner* or *later* produced, because these expressions denote *Parts* of *Time*: Now it is apparent that *Time* presupposeth the *World* and the *Creatures*, and is a concomitant of them.

CHAP. III.

The World is not Circumscribed by any Figure or Bounds.

I. *Some deny insensible parts in Bodies, because they cannot see them.*

THOSE who derive all Knowledge from their *Senses*, cannot conceive that there should be any sensible parts of *matter*, of which *Bodies* are framed, only for this Reason because they cannot see, or perceive them by any of their *Senses*. For they think it to be an absurd thing, that any thing should be represented to the *Mind*, which comes not in by the *Senses*.

II. *Some suppose the World to be of a Round Figure.*

There are some of these, who after that they have asserted, that all the *Bodies* in the *World* consist of three *Dimensions*, and that none of them can be imagined so small, but that they consist of various *Sides* and *Surfaces*, do conclude the *World* to be of a *Round* or *Spherical Figure*, so that all the *Lines* drawn from its *Center* to the *Circumference* are equal. The chief ground of this their assertion is, because a *Round Figure* is the most perfect of all, and most conservative of the *Body* to which it belongs: And that the *Universe*, as being the most noble of all *Creatures*, must needs have the most excellent and useful *Figure*. And they defend their Opinion by *ARISTOTLES Authority*, who saith, that nothing is corrupted but by its *contrary*; and that seeing the *Heavenly Bodies*, are *Ingenerable*, and *Incorruptible*, it was necessary they should have such a *Figure* whose *motion* hath no contrary.

III. *A Round Figure conduceth nothing to the Incorruptibility of Bodies.*

But *ARISTOTLES Authority* must not be more prevalent with us than *Reason*; for if a *Round Figure* were conducive to the everlasting Permanence of things, it would follow, that things of that *Figure* must be *Incorruptible*: Yea, it would depend on our Will to make things *Incorruptible*; since it is in our Power to make *Wood*, *Wax* and such like *Bodies* of a *Round Figure*. Nay, if this were true, there would be no *Bodies* in Nature, but what would be Incorruptible, forasmuch as all of them have some kind of *Roundness*; because a *Circular Figure* lies hid under their *Angles*; and therefore a *Cubical* or *Square Body*, as to its *Spherical Figure* would be *Incorruptible*, whereas its *Angles*, which cover the said *Roundness* would at the same time be Corruptible.

IV. *A Round Figure is not the best of all other.*

Neither is a *Round*, more excellent than any other *Figure*; for seeing that every *Figure*, especially those that are Regular, have their *Beauty*, yea, and that those are lookt upon to be more curious, which have most of variety, why should not a *Body* of 8, 12 or 20 *Sides*, be more excellent as to its *Figure*, than a *Globe*? Or shall we think a *Round Figure* to be most beautiful because it is most smooth, and most even? If so, why are not all precious *Stones* rather formed into a *Round Figure*? And why is not Man, who is the most excellent of all other *Creatures*, of the same Shape? Wherefore I will conclude with VELLEIUS; *I Wonder at those who will have the World to be a Living Creature, Immortal, Happy and of a Round Figure, because* PLATO *denies that any Figure is more Beautiful than it; whereas in my Mind, that of a*

a Cylinder, or a Square, or a Long Figure, or Pyramid do exceed it.

V. *No Bounds can be assigned to the World.*

But if we consider the *Nature* of a *Body* or *Matter*, we shall be convinced, that no *Figure* can be ascribed to the *World*: For the *essence* of a *Body* consists in *Extension*, so that whatsoever hath three *Dimensions* must be a *Body*. Which being granted, it will follow, that the whole *World* cannot be terminated by any *Figure*, because whatsoever we can imagin without the *Bounds* of that *Figure*, must be a *Body*, neither can it otherwise be conceived by us, than as extended in *Length Breadth* and *Depth*: For *Nature* abhors a *Vacuum*, neither can any space be assigned, which is altogether empty, that is, devoid of any *Corporeal Substance*.

VI. *That the World is immense.*

Wherefore we cannot represent the *World* so great to us, but that we may still conceive it greater; for tho' we may conceive that probably there are many *Bodies* like the *Earth*, that may be inhabited by diverse *Animals*, yet is it impossible for us to conceive many *Worlds*, forasmuch as that wherein we are, takes up more space than we can imagin.

VII. *An Objection fetched from the Termination of the Parts of the World.*

Some endeavour to prove the *World* to be *bounded*, because it consists of divers *Parts*, whereof some one begins its *Magnitude*, and some other terminates it; and seeing that all the *Parts* of *Matter* are *bounded*, that which results from them must needs be terminated also; because *every thing that is Divisible is Finite.*

VIII. *Answer.*

This *Argument*, how much soever they may value themselves upon it, is very inconsiderable, and more thwarts their own sentiment, than ours. For no *Philosopher* ever denied that *Matter* was Partible, since *Divisibility* is its property; yet no body ever acknowledged, that by dividing *Matter*, we can ever come to its last *Particle*. Wherefore they infer wrongly, that the *World* is *Finite*, because it hath *Parts*; for the inference from hence rather ought to be, that the *World* is *Indefinite*, seeing that beyond all the Bounds we can possibly assign it, we still find extended spaces, nor can our *Imagination* ever reach to any last or utmost limit that might bound it.

IX. *What we are to understand by the name of Space.*

This matter will be further cleared, if we consider what Space is, and how it differs from a *Body*. By the name of *Space* we understand all that Extension, which we conceive as reaching in *Length*, *Breadth* and *Depth*; so that Space properly speaking is nothing else, but *Internal* Place, whereby the *Magnitude*, *Figure* and *Situation* of *Bodies*, amongst other *Bodies* are determin'd. And Space thus described doth not indeed differ from a *Body*, but according to our way of conceiving; because we conceive the Extension of Space, as something *common* and Generical; whereas we consider the Extension of a *Body*, as something *Individual* and *Singular*. As for Example, when a *Tower* is taken away, we imagin that its extension is also taken away, because we conceive the same as *Singular*, and belonging only to it, and suppose the Extension of the place, wherein the *Tower* was contained, to remain the same, tho' another Building be erected in the same place, or some other like *Body* be placed there. Because here Extension is considered in common, and is lookt upon to be the same, whether of a *Building*, the *Air*, or any other *Body*, so it be but of the same *Bigness* and *Figure*, and in the same Relation, of Distance or Nearness, to those External *Bodies* which determin that place.

X. *Space and Body are the same.*

We see then, that it is the same *Extension* that constitutes the *Nature* of a *Body* and *Space*, and that there is no other difference between these two, but that which there is between a *Genus* or *Species* and an *Individual*, that is, between the Nature of a *Man* considered in *General*, and that of *Anthony* or *John*. And as we say, that a *Whole* includes all its *Parts*, and all the *Parts* united together, comprehend the *Whole*: So tho' Space be said to include a *Body*, and a *Body* to be placed in a *Space*, yet cannot a *Space* and *Body* on that account be said to be really distinguisht, seeing that the *World*, which comprehends all things, is not conceived really distinct, from all the *Parts* contained in it.

XI. *That there are no Bounds beyond the World.*

Forasmuch therefore as we can imagin no *end* to *Extension* or *Matter*, but that beyond it we still conceive further Spaces, we must needs assert this *World* to be *Indefinitely extended*, and that it cannot be bounded by any *Figure* whatsoever. And tho' we will not arrogate so much, as to suppose our Mind to be the measure of *Truth*; yet we say, that it must be the measure of whatsoever we do affirm or deny. For it is absurd for us to pass our Sentence concerning any thing, whose Nature we know we cannot reach. Wherefore we make no difficulty, to assert the *World* to be *Indefinitely extended*, seeing we can conceive no Bounds in it.

CHAP. IV.

The matter of Heavenly and Earthly Bodies, it one and same.

I. Aristotles *Opinion concerning the matter of Heavenly and sublunary things.*

IT hath been a frequent Controversy amongst *Philosophers*, whether the *Matter* of *Heaven* were the same with that of *Sublunary things*. *ARISTOTLE* supposing the *Heavenly Bodies* to be *Incorruptible*, will have their matter to be distinct from ours; so that, according to him, there are two parts in the *World*, the one *Elementary*, the other *Cœlestial*. He makes the matter of *Heaven* to be *Ingenerable* and *Impassible*; whereas the *Elementary* is subject to *changes*, capable of all *forms*, and craving those it wants. For if we may believe him, the *Heavens* never suffered any *change*, and continue still in the same state wherein they were *Created*. Because *Generation* and *corruption* are only found amongst *contraries*; and seeing nothing is contrary to the *Heavenly Body*, because its *motion* is such, as to be contrary to none; for one *motion*, according to him, can only be opposite to another *motion*; and since *motion* upwards, is contrary to that which is downwards, it is necessary that *Circular motion*, which is proper to the *Heavens*, must have no contrary, and therefore that *Body* which is so moved must be *Incorruptible*.

II. Aristotles *Argument returnd upon him, and confuted.*

But what if we should grant the *Heavenly Bodies* to be *Ingenerable* and *Incorruptible*, yet would it not follow from thence that they are not subject to any changes, which we may prove by *ARISTOTLES* own Argument. *Those things may be generated and corrupted, that have their Contraries; but that which is Ingenerable and Incorruptible, is contrary to that which is Generable and Corruptible; therefore the Cœlestial Orbs are Corruptible*

ruptible and Generable. But to leave these *Reasonings*, let us see what may be alledged against *ARISTOTLES Opinion.* For asmuch as the *Modern Astronomers*, have more exactly viewd the *Stars* than the *Antients*, I question not, but that were *ARISTOTLE* now alive, and made use of our *Telescopes*, he would be of their Opinion. For they observe that the *Sun* is frequently obscured by *Spots* which obscure its face, and that these at some certain times are so condensed, that the Light of the *Sun* for some Months together, appears much weaker. Now that these are generated, cannot be denied, since almost every day they change their Form; they are sometimes of a *Black colour*, at other times they seem to have a *Dusky* appearance of *Light*; yea sometimes they are of that loose texture, that they exceed the *Sun* in *Brightness*. All which could not be without *Generation* and *Alteration.*

III. *The Planets subject to changes.*

The changes which happen to the *Planets* confirm the same thing; for what is more instable than these *wandring Stars*? The *Moon* almost every day gives a various Representation of herself. *Saturn* seldom appears with the same *face.* How frequently is *Jupiter* clouded with *Spots*, which interrupt its *Light* from coming to us? *Venus* is continually changing, and if we may give credit to the information of the *Telescope*, we must assert her to have several *Faces*; since she does not only change her *aspect*, but also her *Bulk* and *Figure*, as *Astronomers* tell us it happend, in the time of *King Ogyges.* Moreover, how many *Comets* and *New-Stars*, do there appear in the *Heavens*, as the *Star in Cassiopæa*, and others that appeared in the Heavens in 1572 and 1604, above the height of the *Planets.* All which *PHÆNOMENA* may be sufficient to make the followers of *ARISTOTLE* to reject this foolish Opinion of their *Master*, and to acknowledge the Corruptibility of the *Heavens.*

IV. *The Mathematicians have descried many new Stars.*

Neither are we to be moved by what *ARISTOTLE* tells us, that he never perceived any such thing in the *Heavens*, where he saith; *This is likewise abundantly confirmed by Sense; seeing that according to the Records of all past time, never any such change hath happened in the whole utmost Heaven, nor in any of its proper parts.* Well, let us be so favourable to *ARISTOTLE*, as to take this to be true; but can it be inferred from hence, that no further observations could be made for time to come? For we read that *HIPPARCHUS*, 200 years after *ARISTOTLE*, found out a new *Star*, by the motion whereof he began to question, whether this might not happen more frequently, and whether the *fixt Stars* also might not have a *motion* of their own. We know likewise that *TYCHOBRAHE* descried the foresaid Star in *Cassiopæa* in the Region of the *fixed Stars*, above *Saturn.*

V. *Wherein the Essence of Matter doth precisely consist.*

But we may put the Point beyond all Controversy, considering wherein the *Essence* of a *Body* doth consist, and by removing from it whatsoever is Extraneous to it. Thus in the *first* place it appears, that sensible *Qualities* are no constituents of it, since it can be without them, and loseth nothing when they perish. *Air*, which is soft to the *Touch*, doth not change its *Nature*, when by being shut up in a *Bladder*, it appears hard. A *Bean* is of considerable *Hardness*, as long as it abides whole, but when reduced to Flower, it becomes soft. But the *Air* and the *Bean* continues *Bodies* for all that. Neither do *Figure*, or *Motion* conduce any thing to the constitution of *Matter*, since the *World* which is of no *Figure* at all, or at least cannot be conceived by the *Mind* of *Man*, under any *Bounds*, still continues to have the *Nature* of a *Body.* And the *Heavens*, which are considered as *immoveable*, do not therefore cease to be material. And the same may be said of *Heat* and *Cold*, and other like *Qualities*, which may be absent from a *Body*, its Nature continuing whole and entire.

VI. *The matter of Heaven and Earth consists in Extension.*

We conclude therefore, that nothing but *Extension* constitutes the *Essence* of *Matter*, since that *alone* cannot be separated from it, and is Reciprocated with it. For if you take away *Extension*, the *Body* is gone, as when you take away the *Body*, the Extension is no more.

VII. *The matter of the Heaven and of Sublunary things is the same.*

Forasmuch therefore as the *Matter* of the *Heavens* in *Length*, is extended in *Length Breadth* and *Depth*, and that no thing but this Extension is included in the Conception of it, we conclude that the matter of *Heaven* and *Earth* is one and the same, and consequently that the *Matter* of the *Heavens* is as well subject to Corruption and Changes as that of the *Earth* is.

VIII. *Objection that the matter of Heaven and Earth is not under the same Forms*

You'l say, that the *Heavenly Matter* is not under the same *Forms* as *Sublunary things* are, because it was never known that *Heaven* was generated of the *Air*, or that a *Star* was changed into an *Earthly Body.*

IX. *There are no Forms but may inform Cœlestial Bodies, as well as Terrestrial.*

If by the name of *Forms*, in the Objection, be understood those *Substantial Principles*, which have a different *Being* from the *Matter*, and together with it constitute a *Natural Compound*, I say, that such Forms as these are meer *Fictions*, and useless to the explaining of *Natural Effects.* For such *Forms* must be either *Material* or *Immaterial.* If *Immaterial*, of what use can they be to *Matter*? How can they perfect it, and communicate to it their *Essence*, since *Matter* (according to them) is *meer Potentiality*, which derives all its *Existence* from these *Substantial Forms.* For how can that which hath no Parts, constitute the *Essence* of a *Material thing*? But if they suppose these *Forms* to be *Material*, then must they of necessity be constituted by *Extension*, and must be subject to the self same *Modes* of Variation, which all other *Bodies* are. For it cannot be conceiv'd that a thing should be extended, without being liable to the change of *Figure*, *Motion*, *Magnitude*, *Rest* and *Situation*: And forasmuch as *Generation* is nothing else but a congruous Adaptation of the *Insensible* or *Sensible Parts*, according to the foresaid *Modifications*, we must conclude, that all *Matter* is subject to Changes, and consequently, the *Elementary Matter* doth not differ from the *Heavenly.*

CHAP. V.

What the Form of the World is: Whether it be the Soul, that is, the Spirit of Nature, or the most excellent Disposition of its Parts.

I. *The Opinion of Pythagoras and Plato, concerning the Soul of the World.*

THere is nothing that hath been more controverted amongst the *Ancients* than this *Question*, Whether the *World* be endued with a *Soul*, and vivified by an *Internal Spirit*, diffus'd throughout all its Parts. *Pythagoras* and *Plato* have compared the *Universe* to *Man*, and maintain'd it to be

be furnish'd not only with *Life* and *Sense*, but also with *Understanding*. For they could not conceive, how that which was devoid of *Sense*, should produce Sensible things. And therefore as there is in us a Power whereby we *live*, are *sensible*, and *move*, they thought that so likewise in the *World* there must be a *Principle*, from whence all its Operations flow; which the *Poet* describes thus,

The whole, an Inward Spirit doth maintain,
And a great Soul infus'd through ev'ry Vein
Th' unweildy Mass doth move.

II. *What the Soul of the World is, according to* Plato.

Tho' *Plato* suppos'd the *Soul* of the *World* to be like that which is in *Animals*; yet he holds it not to be a *simple Substance*, but compounded of two *Parts*; the one purely *Intellectual*, the other more *Impure*, tho' *Pure*, if compared with the Grossness of *Bodies*; and this he makes a kind of Vehicle of the *Immaterial part*. So that he makes a distinction between the *Mind* and the *Soul*; the *Mind* being a *Substance* void of all *Matter*, which is the Higher part of the *Soul* of the *World*; and the *Soul* being nothing else but the most *subtil Æther*, by means whereof the *Mind* is brought and united to the *Body*.

III. *In what sense this Opinion of* Plato *may be admitted.*

Tho' this Opinion of *Plato* at first sight appears strange and absurd; yet in a sound Sense it may be asserted. For if by the *Soul* of the *World* he meant nothing else but *GOD* himself, who holds together the dispersed *Parts* of the *World*, animating, governing and cherishing them, it contains nothing contrary to *Faith* or *Reason:* Provided always, that *GOD* be understood not to be the *Informing Soul* of the *World*, that is, a Constitutive part of it; but an *Assistant form* only, that is, the *Ruler* and *Governour* of *Nature*. For *GOD* is the *Moderatour* of all Things, and is present to all Things, whether *Intellectual* or *Bodily*, operating in them, and by them, according to that of the *Acts* 17. 28. *In him we live, move, and have our Being.*

IV. *Absurdities consequent to* Plato's *Opinion.*

But if *Plato*'s meaning was, That this *Universe* was endued with a true *Soul*, and accordingly was a *Real Animal*, from whence all other *Animals* are generated, nothing seems more absurd, than to suppose an *Animal* compounded of an infinite sort of other *Animals*, which feeds upon it self, and yet is destitute of *Sight*, *Hearing*, and the other *Senses*. What, are the *Stars* nourished with terrene *Exhalations?* Or is the *Earth* supported by Emanations from the *Body* of the *Moon?* Who will believe such stuff as this? If the *Earth* be sensible, what shall we say of those hard-Hearted *Husbandmen*, which do cut and wound it with their *Plough-shares?* Besides, if we grant the *Earth* to be *Animate*, must not *Stones*, *Iron* and *VVater* be so likewise; yea, all other things of the *VVorld?* But you'l say, *Living Creatures* are generated out of the *VVorld*. What then? Must I thence conclude that the *VVorld* is an *Animal?* Why may not I as well conclude the *VVorld* to be all *Stony*, because *Stones* are generated out of it? Or of *Iron*, because its *Bowels* produce *Iron?* Yea, why may I not with equal ground conclude the *VVorld* to be a *Fidler*, or a *Mathematician*, because such are born in it? For tho' whatsoever hath its Original in the *VVorld*, doth derive the same from something that is in the *VVorld*; yet not therefore from the *Soul* of the *VVorld*, that is diffused throughout it, seeing that the *VVorld* contains all manner of things, whether *Animate* or *Inanimate*.

V. *Supposing one common Soul of the World, all Men would feel the same thing.*

But to urge this with more *Philosophical Arguments*, I say, that upon this Supposition of a *Soul* being diffus'd throughout the whole *World*, it will follow that there can be no Passion of *Joy* or *Sorrow* in the *World*, but what all *Men* must be sensible of, and that no Body can *wound* or *strike* another, without feeling the same himself. For if one *Sensitive* and *Rational Soul* governs and animates the *World*, there must accordingly be but one *Animadversion*, that is, one part of it must perceive whatsoever the other parts do. But we experience the contrary to all this, and therefore must conclude, that there is no such common *Soul* in the *World*.

VI. *And would remember things they never had perceived.*

For otherwise we should not only apprehend things offer'd to our *Mind*, but we should also remember those things, which were never committed to our *Memory:* For seeing that this Universal *Soul* contains all things, and is diffus'd through all, nothing of all the things that are acted any where, could be hid from it; and therefore since by it we perceive *Objects*, and remember them, it must necessarily follow that the *Mind* must behold those things as present, which it never enquir'd after; that is, it must remember those things, which it never perceived.

VII. *Yea, and would remember those things as done in one Part of the World, which were done in another.*

Moreover, if we suppose the *World* to be whirl'd about its *Axis* in 24 Hours time, it will follow, that whatsoever I set about when the *Earth* is in the Beginning of *Aries*, I shall remember to have done the same when the *Earth* is in the Beginning of *Libra*; tho' that Portion of the *Soul* of the *World*, which informs my *Body* at that time, be then as far from me, as the *Earth* is from the *Sun*. Which *Arguments* sufficiently prove, that there cannot be a *Soul* common to all Men.

VIII. Henry More's *Opinion of the Spirit of Nature.*

Doctor *More*, tho' he doth not defend *Plato*'s Opinion concerning the *Soul* of the *World*, and thinks it absurd, that a Substance endued with *Sense* and *Reason* should be mingled with all the *Parts* of the *World*; yet he admits of a *Spirit* of *Nature*, which penetrates all the *Matter* whereof the *World* consists, and exerts its *Power* in it; which *Spirit* he describes to be (in his *Third Book* of the *Immortality of the Soul*) *an Incorporeal Substance, but destitute of Sense and Animadversion, penetrating the whole Matter of the Universe, and exercising a Plastick virtue in the same, according to the various disposition of the Parts in which it operates, directing the Parts of Matter, and their Motions, and discovering those* Phænomena *in the World, which cannot be resolv'd into meer Mechanical Causes.*

IX. *Experiments to prove the Spirit of Nature.*

The *Arguments* that persuaded the *Doctor* to admit this *Spirit* of the *World*, were the *Trembling* of an *Unison String*; *Sympathetick Cures*; the *Sympathy* there is between *Heavenly* and *Earthly Bodies*; *Monstrous Birds*; the *Magnetick Attraction* of *Iron*; and lastly, the *Sphærical Figure* of the *Sun*. For he could not apprehend how the *Unison Strings* of different *Instruments* do all of them shake, if *One only be touched*, without the assistance of this *Spirit* of the *World*. How by the *Weapon-Salve* a VVound can be Cured at a great

great distance. How the *Heavenly Bodies*, which are assumed by *Magicians* and *Witches*, do communicate their Affections to *Earthly things*; and how it comes to pass, that the same things that hurt those, do mischief to these also. How *Monstrous Birds* come to be generated in a *Human Womb*. How it comes to pass that *Iron* is attracted by the *Loadstone*, and of it self, without any impelling *Cause* is carried towards it. How the *Sun* attain'd its *Round Figure*, except this *Spirit* of *Nature* be admitted, *permeating* all the *Matter* of the *World*, into which all these *Phænomena* may be resolved.

X. *Why an Unison String trembles at the shaking of another on a different Instrument.*

But I see no necessity of having recourse to a *Spirit of the World* for the explaining these *Phænomena*, since it may better be done by *Mechanical Principles*. For, as to the *First*, the *Trembling* of an *Unison String*, upon the *striking* of another, whilst all the other Strings remain without any *Motion*; this is caused by the vibration of the *String* struck, which *moving the Air*, the *Air* reacheth the *String* that's wound up to the same pitch, and makes it tremble; the *Trembling Motion* being easily communicated to a *Body* disposed for such a *Trembling*; and therfore no wonder if it give forth the very same *Sound*. Whereas if the *Trembling Air* rusheth against a *String* that is differently *wound* up, by giving several hits against it, it hinders it from reverberating; so that it is impossible for it to sound as the other doth. Yet we must not imagine, that only those *Strings* which are tun'd alike do shake, since they do all, or most of them shake; tho' those only do *sound*, which are in *Unison* or *Diapason*, or some other Concord with the *String* struck.

XI. *Whether Wounds are Cured by the Sympathetick Powder.*

As to the *Cure* of *Wounds* by the *Sympathetick Ointment*, or the *Powder* of *Calcin'd Vitriol*, and that at a great distance; this is a thing which may very well be question'd. For what is there in *Vitriol* to perform this, save only an *Adstringent virtue*, whereby it is proper to stop *Blood*, and to bring it to a *Scar*? But by what means shall the outflowing *Particles* thereof be guided to the *Wound*, since they only exert themselves to a very small distance? Whence the *Doctor* concludes, they are directed to the *Wound* by this *Spirit of Nature*. But forasmuch as this *Spirit* is diffus'd throughout all the *World*, and indifferently present to all *Wounds*, why doth it rather heal that whence the *Blood* came, than all the rest, since it is destitute of *Sense* and *Animadversion*, and is no more present to that *Wound*, which it is supposed to *Cure*, than to any other? Wherefore when a *Wound* at a great distance happens to be Cur'd this way, the *Cure* is not to be ascribed to the *Powder* or *Weapon-Salve*, which is apply'd to the *Instrument* that made the *wound*; but it seems to happen, because the *wound* is kept clean and wash'd with *Urine*; as is prescrib'd in this case: For *Salt of Urine* is very detersive and adstrictive, and therefore readily closeth the Mouths of the *Veins*, consolidates the Parts, and *skins* them over.

XII. *There is no sympathy between Heavenly and Earthly Bodies.*

As to that particular of *Mens Souls* sometimes quitting their *Bodies*, and appearing in the shape of a *Cat*, *Dog*, *&c.* and that whatsoever is inflicted on these assumed *Bodies*, doth redound to the hurt of their true *Earthly Bodies*; this I take to be impossible, and therefore think it in vain to trouble my self about searching out the Reason of it.

XIII. *How Monstrous Birds are framed in the Wombs of Women.*

As to those *Monstrous Birds* and *Animals*, that sometimes proceed from the *Wombs* of *Women*, there seems no necessity to put this drudgery upon this *Spirit* of *Nature*, when it may be more commodiously explicated by a propension in the Matter apposite to the *Forming Power*, and the intention of *Nature*. Thus we find that the Seed of *Coleworts* degenerates into *Turneps*; and why may not we as well suppose that the Parts of an *Animal* may be perverted, by manifold defects of the *motions* and *humors* of the *Womb*, discomposing and altering the *Seed*. And indeed, what wonder is it for a *Woman* to bring forth a *Monster*, when we see the *Body* of *Man* familiarly to breed *Lice*, which are dreadful Monsters when beheld with a *Microscope*. Seeing therefore that *Lice* and *Worms* are apt to be *generated*, especially where the Parts of the *Body* are ill affected; it will not seem strange that in a depraved state of the Womb *Monsters* should be generated. But of *Monstrous Births*, see more in my *History of Nature*.

XIV. *Magnetick virtue in the Loadstone, elsewhere handled at large.*

The Reason of the *Loadstone* drawing *Iron*, shall be treated at large in the *Tenth Chapter of the Sixth Part*. And so likewise the Cause of the *Round Figure* of the *Sun*, and *Fix'd Stars*, will be handled in the *Fourteenth Chapter* of this *Part*; to which I refer the *Reader*, to avoid Repetitions.

XV. *The Form of the World consists in the most excellent Constitution of its parts.*

Forasmuch therefore as the *World* is not endued with a *Soul*, or any *Spirit of Nature*, there being no need of either of them for explaining any *Natural Phænomena*, we conclude, that the Form of the *World* is nothing else, but the fit disposition of all its *Parts*, and their intimate Union. For such is the constitution of the *Parts* of the *World*, that tho' they be different, and at a distance from each other; yet they have a mutual *Relation* and *Reference*, and are joyned together by a *virtue* that penetrates them all. But what *virtue* is this that unites them? I answer, that it is the *Subtil* or *Æthereal Matter*, which permeating all *Bodies* is the cause of this *Union* and *Harmony*, as LUCRETIUS seems to hint, *Lib.* 5.

The Fluids are all differently Light,
And therefore reach'd the less or greater height.
Then Liquid Æther did the farthest rear,
And lies on softest Beds of yielding Air.

CHAP. VI.

That GOD, as he is the Efficient and Conserving Cause of Matter, so likewise of Motion.

I. *Nothing in the World is annihilated.*

HAving thus explain'd the *Nature* of the *World's Matter*, and enquired of the *Soul* that acts it, it remains now that we consider, whether the same *quantity* of *Matter* always remains in the *World*, or whether it be increased or diminished. Some are so stupid as to imagin, that when *Fire* is extinguish'd, it wholly perisheth; not considering that GOD is the *Creatour* of all things, and that the *Creatures* cannot destroy any thing, which his *Omnipotence* hath produced. For tho' the subtil *particles* of *Fire*, may by a *Fan*, *Bellows*, or the *blast of ones Breath* be dissipated; yet are not they therefore annihilated, but being sepa-

rated exiſt in another manner than they did before. For as *Diviſion* doth not make *Matter*, ſo neither can it deſtroy it: Wherefore, *Matter* divided loſeth nothing of its *extenſion*, but only ceaſeth to be ſuch a *Body*, and becomes changed into another. It is a great miſtake to ſuppoſe, that thoſe things which ceaſe to affect our *Senſes*, are altogether deſtroy'd and annihilated.

II. *Matter is neither ſubject to Generation, nor Corruption.*

Matter, according to the Opinion of all *Philoſophers*, is neither *ſubject to Generation*, nor *Corruption*: Wherefore, we muſt conclude, that there is always the ſame *quantity* of it. For indeed how can any *new Matter* enter, ſeeing there is no *Vacuum*, and that the *penetration* of *Bodies* implies a Contradiction? For if any one part of the *Eyes* ſuppoſe, ſhould be taken away or annihilated (as they fancy of the *Fire*, when it goes out) it is certain a Space muſt be left in the room of it, which foraſmuch as it hath *length*, *breadth* and *depth*, we muſt ſay that another *Body* ſupplies the place of it. For it becomes the *Infinite Power* of GOD, to act in the moſt *conſtant* and unchangable manner, by preſerving that which he hath produc'd without increaſe or diminution.

III. *How New Bodies are brought forth in the World.*

But you'l ſay, That we daily ſee new Parts of *Matter* appearing, which were never before: Thus *in Spring time many Herbs and Flowers ſhoot forth from the Earth; and in Autumn, the Trees are loaden with Fruits, which did not exiſt before.* Wherefore we may conclude, that the *Subſtance* of *Matter* is increaſed.

This Difficulty may be eaſily ſolved, by diſtinguiſhing between the *Firſt* and *Second Matter*. By the *Firſt Matter* is underſtood a *Body* in its general Notion, as it includes three Dimenſions. By the *Second Matter* is meant a *Body*, which beſides *Extenſion*, is endued with *Figure* and other Modifications, by which it comes to reſort under one or other of the *General Heads* of *things*. Wherefore a *Body* in this ſenſe is not to be called *Simple Matter*, but ſomething compounded of an *Extended Subſtance*, and one or more *Modifications*. Thus a *Tulip*, for Example, *beſides Extenſion*, *implies ſuch a conformity of Leaves*, *which at different Seaſons riſe and periſh*. And this *Second Matter* admits ſome kind of *Latitude*, and may be multiplied or diminiſhed. But the *Firſt Matter* is Indiviſible, ſeeing that all Bodies agree in *Extenſion*; the *Soft* and *Inſenſible*, as well as the *Hard* and *Senſible*. And ſuch *Matter* as this, is neither ſubject to *Generation* or *Corruption*, and conſequently can neither increaſe or be diminiſhed, being only capable of admitting different *Modifications*, and of aſſuming divers *Forms*.

IV. *GOD is the Cauſe of the Motion that is in the World.*

And the ſame is the caſe with *Motion*, foraſmuch as all things proceeding from GOD, depend on him in a peculiar manner, and have nothing of *Truth* or *Goodneſs*, but what they have received of him: And that *Independency* is the neceſſary *Attribute* of a moſt *Perfect Being*, as *Dependency*, as to *Being* and *Conſervation* is the *Attribute* of all *Creatures*. For who can believe that the *Motion* of the *Stars* about their ſeveral *Centers*, the Courſe of *Rivers*, the daily *Ebbing* and *Flowing* of the *Sea*, and the *Earths* being poiſed in the *Liquid Air*, are cauſed and continued by *Chance*? It implies a Contradiction to ſuppoſe theſe *Regular Effects* to be produc'd by any Power, beſides that of a moſt *Perfect Being*, who not only *created Matter*, but alſo imparted *Motion* and *Reſt* unto it. And ſince the Conſervation of any thing is a continued *Creation*, we muſt conclude, that GOD is the Preſerver of that *Motion*, which at the Beginning he imparted to the *VVorld*.

V. *That GOD, as he continues the ſame Quantity of Matter in the VVorld, ſo likewiſe of Motion.*

So that as GOD preſerves the ſame *Quantity* of *Matter* which he *created*, ſo likewiſe of *Motion*, and that without increaſe or decreaſe; which is a remarkable *Proof* of GOD's *VViſdom* and *Unchangableneſs*. And as for *Matter*, as it could not move *it ſelf* at firſt; ſo it being once put in *motion*, it never ceaſeth from it, but continues in the *ſtate* wherein it is put. So that if the *Motion* that is in the *VVorld* ſhould either be diminiſhed, or ceaſe altogether, this muſt be from the *Divine VVill* appointing it ſo; but no ſuch *VVill* of GOD appearing, it is certain the ſame *Quantity* of *Motion* muſt ſtill continue in the *VVorld*.

VI. *In what ſenſe it is to be underſtood, that the ſame Quantity of Motion is ſaid to continue in the VVorld.*

When I ſay, that the ſame *Quantity* of *Motion* is preſerv'd in the *Univerſe*; this is not ſo to be underſtood, as if all Bodies that were firſt put into *motion*, continue in the ſame *motion*; and that thoſe that were left at *Reſt*, do perſevere in the ſame; but that the ſame *meaſure* of *Motion* is preſerved in the whole *Univerſe*, tho' it may be varied and alter'd in the particular *Parts* of it, with reſpect to the diverſe *Bodies*, on which it exerciſeth its *force*. Much in the ſame manner, as we ſay, that in a certain *Kingdom* there is ſuch a determinate *quantity* of *Mony*, tho' ſome Men have more of it, and others leſs, and tho' it be in a continual Relation from one to another. So likewiſe we muſt conceive, that the ſame *quantity* of *Motion* is found in the *Univerſe*, tho' the ſame be variouſly poſſeſt by the particular *Parts* of it.

VII. *God makes uſe of the ſame Force, in applying Motion to divers Bodies.*

GOD alone can be the *Cauſe* of this ſo conſtant *Motion* in the *Univerſe*. For if we conſider *Motion*, we find nothing by which it ſhould be increaſed or diminiſhed, for having not produc'd it ſelf, neither can it increaſe or deſtroy it ſelf; nor can the *thing moved*, or *matter*, conduce any thing this way, becauſe it is meerly Paſſive, and conſiſts only in *Extenſion*. Wherefore, we muſt conclude GOD to be the Total and Univerſal *Principle* of *Motion*; who at the firſt inſtant of the *Creation* of *Matter*, put *Motion* into it, and maintains the ſame by the ſame *Action* wherewith he preſerves the *Matter* it ſelf; that is, he makes uſe of the ſame *moving Force*, without increaſe or decreaſe, which removes from one *Body* to another, according as GOD applies the ſame to divers *parts* of the *World*. For it might ſeem to be an *Argument* of *Inconſtancy* in GOD, if he did not maintain the ſame *quantity* of *Motion* in the *World*, as well as of *Matter*, and this by one and the ſame Concourſe. So that the *Force* whereby *Matter* is moved, is nothing but GOD himſelf, who being moſt *Wiſe* and moſt *Powerful*, acts in the moſt ſtable manner; and therefore on his part, this *virtue* can neither increaſe or be diminiſhed, but ever continues the ſame, tho' in particular *Subjects* it may be various.

VIII. *An Objection taken from God's free Action.*

But you'l ſay, GOD is a *Free Agent*, and that Things that are done in the *Univerſe* proceed from his *Will*. For who knows not, that the *Number* of Men depends on his *good Pleaſure*, who produceth and preſerves more or leſs of them, as he pleaſeth? So that there ſeems no reaſon, but that there may be an unequal *meaſure* of *Motion* in

in the *World*, seeing that according to the *Free Will* of the *Creatour*, it may be increased or diminished.

IX. *The First Answer.* To which I Answer, *First*, That those *Things* which depend on the alone good Pleasure of *GOD*, cannot be known but by *Divine Revelation*; wherefore the Consideration thereof does not belong to *Natural Philosophy*, wherein nothing is to be admitted, but what may be discovered by *Reason*.

X. *The Second Answer.* In the *Second* place I Answer, That as *GOD* acts freely, so likewise he acts *constantly*, and *immutably* preserves whatsoever he hath once produced. So that we are not only to consider the *Liberty* of *GOD*, but the same in conjunction with his other *Attributes* of *Wisdom*, *Unchangableness*, *&c.* which all together do constitute his one *Eternal* and *Permanent Nature*. And as his *Liberty* appears in the vast Variety of the *Things* he hath made, so his *Unchangableness* is demonstrated by his conserving the same *Quantity* of *Motion* and *Rest* in the *Universe*. For *Conservation* being a continual *Production*, it would seem to argue *Changableness* in *GOD*, if either any *new Motion* should arise, or præexistent *Motion* should perish.

XI. *There can be no Inconstancy in Motion, neither in respect of GOD, nor of the World.* We acknowledge indeed, that such is *GOD*'s absolute *Power* of all *Things*, that he can destroy, lessen or increase, whatsoever he hath made, according to the pleasure of his *Will*: But as long as such his *Will* is not discover'd to us, we cannot assert any thing concerning it. And seeing that with respect to the *World*, no Reason can be given for the increase or decrease of the *Motion* that is in it, we must conclude that the same *force* which at first put the *Matter* in *Motion*, doth still continue in it.

XII. *Whence so many Motions arise in the World.* It remains now, that we explain how this *Motion*, or rather *Virtue*, that *moves* the *Parts* of the *Universe*, does indivisibly continue the same, when so many *New Motions* are seen every day: As when *Men*, and other *Animals*, that rested in the *Night time*, are all in *motion* in the *Day*; and when *Guns* are discharged, it is certain that the great Concussion caused thereby, was not before in the *World*; wherefore, it seems there must needs be more *Motion* in the *World* at one time, than at another.

XIII. *A Body moved, dashing against another, doth communicate some part of its motion unto it.* But this will be easily answered, if we consider that *every Body whilst it pusheth on another, doth lose as much of its own motion, as it transfers to that Body it pusheth forwards.* As appears in *hard Bodies*, which by dashing against any soft *matter*, transmit all their *motion* to it, and are reduced to *Rest*. Hence it is, that a *Stone* falling down from on high to the *ground*, doth not rebound, but lies still, because it communicates all its *motion* to the *Earth*. And in like manner, when *Men* or other *Animals* are moved, we must not suppose that they produce *new Motions* in the *World*, when the agitation of their *Spirits* is transmitted to their *Members*; because the more *motion* the *Members* receive, the less the *Spirits* retain.

XIV. *The Concussion of the Air by Guns, does not prove a greater* Neither can we infer, that the *Quantity* of *Motion* is increased by the Concussion of the *Air*, caused by the discharge of *Canon*: For tho' there may be more of that *motion* which we call *sound*, yet is there no more *motion* simply taken: For tho' the commotion of the *Air* be at first made more vehement, because of the narrowness of the *Space*; yet by degrees afterwards it becomes more remiss, as it spreads into wider *Intervals*, because the *Air*, having communicated its *motion* to the Neighbouring *Bodies*, doth lose as much *agitation* as it imparts to them. *Quantity of Motion.*

CHAP. VII.

Of the Action of Bodies, and the Communication of Motion.

I. *There is a manifold Communication of Motion.* FOrasmuch as the *Matter* of the *Universe* is divided into innumerable *Parts*, and every one of them have their *proper Motions*; it cannot be doubted but that they must frequently run against one another, and by contrary *motions* be either hindred, retarded, or wholly reduc'd to *Rest*. Hence, according to the variety of their pushing against each other, the manifold *Action* of *Bodies*, and Communication of *Motions* ariseth: *First*, When two *Bodies* by *Contrary motions* run against each other: *Secondly*, When the *Body* moved, runs against a *Body* that is at *Rest*: *Thirdly*, When two *Bodies* are moved the *same way*, but with a different degree of *Swiftness*. For it is impossible that *Bodies* should push against one another, but that some change of *Motion* or *Rest* must follow thereupon.

II. *Wherein the Communication of Motion doth consist.* The *Communication* therefore *of Motion* consists in this, that *according to the Will of the First Mover, the Body that doth exceed the Body it meets with in the Force of moving forward, doth carry the same along with it, and loseth as much of its Motion, as the other receiveth: So that the same Quantity of Motion always continues in the World.*

III. *In the Communication of Motion, an Accident doth not move from one Subject to another.* Neither must we infer from hence, that upon this Supposition an Accident must remove from one *Subject* to another; because the *Body* that is at *Rest*, doth not receive the same *Numerical Portion* of *Motion*, from the *Body* that runs against it: But forasmuch as according to the Will of the *First Mover*, a *like motion* only ariseth in that *Body*, which upon the impulse of another, begins to move (as has been before explain'd, *Part* IV. *Chap.* XV.) it cannot be said, that in this case an Accident removes from one *Subject* into another.

IV. *In order to the exact Determination of the Action of Bodies, it is required that they be perfectly hard.* This *Communication* of *Motion* will be the better apprehended, if we suppose the *Bodies* that are moved to be perfectly *Hard*, and so divided from all the rest, that their *motion* be neither hindred nor promoted by any circumjacent *Bodies*. For except *Bodies* were perfectly *Hard*, they would not be able to act upon one another; and if they were not separate from all others, so as not to be retarded or turned aside by *Ambient Bodies*, the proportion or difference of *Motions* would not be discernible.

V. *And that the Medium in which they are moved, be no hindrance to their Motions.* In the *Second* place, we are to suppose, that the *medium* wherein the *Bodies* move, be such as doth neither hinder nor promote the *motion* of them. For if the way through which they pass be either *soft* or *fluid*, it will hinder their *motion*, turn it aside, or wholly take it away; and so no exact account could be taken, what the Force of each *Body* is in *acting* or *resisting*.

Thirdly,

VI. *A Body is not changed but from an External Cause.*

Thirdly, We are to suppose, that every *Body*, forasmuch as it is simple and undivided, doth as much as in it lies, continue in the same state; nor is it ever changed, but by some *External Cause*. These things being thus far setled, we are, *first*, to enquire, what must happen at the meeting of two *Bodies*? For every one knows by Experience, that *Bodies*, whether *Moved* or *Resting*, variously change the condition wherein they are, according to the different Nature of the *Bodies* they meet with. Thus, for Example, a *Body* moved changeth its state, by meeting a *Body* that is at *Rest*, otherwise than it would by meeting with a *Body* in *motion*. It also variously changeth its *motion*, in meeting with a *hard* or *liquid* Body. And the *Rules*, according to which these Changes happen, are properly that which we call in general, the *Laws of Motion*.

VII. *What Direct Motion is*

Lastly, We are to presuppose, that *Direct motion* is the Translation of a *Body* out of the Neighbourhood of one that is consider'd as *Resting*, into the Neighbourhood of another, by a right line, which is the shortest of all others, and equally stretch'd out between two *Points*.

VIII. *The First Rule.*

Suppose we therefore the two *Bodies* A and E *to be equal, and to move directly towards one another with the same swiftness; when they come to* D, *they will both rebound back the contrary way,* A *towards the Left, and* E *towards the Right, with the very same swiftness wherewith they came to D.* For these *Bodies* being supposed altogether *equal*, must consequently have equal force of *Moving* and *Resisting*. And seeing that *Motion* is not contrary to *Motion*, there is no cause that can reduce them to *Rest*: Wherefore we must conclude that they must reflect or rebound with the same swiftness, their *Motion* continuing whole and entire.

Figure 15.

IX. *The Second Rule.*

But if the Body A *be somewhat Bigger than* E, *and both be moved with the same swiftness,* A *towards the Right hand, and* E *towards the Left, when they meet together in* D, E *alone will rebound, and afterwards both of them proceed to move, with the same swiftness towards the Right.* The Reason is, because every *Body* that hath less Force, to proceed in a *right line*, than the other hath to resist, loseth the Determination of its *Motion*: And it being supposed that the *Body* E hath less force to proceed forwards, towards the Left, then A hath to proceed to the Right, it follows that E, must lose its Determination, that is, must *rebound*; but because A and E, are supposed to move with the same swiftness, and this swiftness cannot be changed by any *External cause*, therefore it remains in the same state wherein it was before. And accordingly E, will move towards the Right, with the same swiftness it had at first; and A retaining the same swiftness, without changing its Determination, will move the same way, and follow E, yet without being able to push it forward.

X. *The Third Rule.*

Again, *if these two Bodies* A, *and* E, *be supposed equal in* Bulk, *but that* A *moves somewhat swifter than* E, *then not only* E *will rebound backwards, but* A *will also communicate to* E, *the one half of its swiftness, wherein it exceeds* E. That is, if before there had been six degrees of swiftness in A, and four only in E, after their meeting, they would both tend to the *Right*, with five degrees of swiftness, and so proceed to move the same way with the same swiftness. For seeing that the *Body* E, hath less force to resist, than the *Body* A, against which it pusheth, hath to move it, it is agreeable to Reason, that it should give way and reflect, and suffer something from the *Body* A, and that so the *Body* A should immediately follow E. But seeing that A hath more *Swiftness*, it cannot follow E, and proceed the same way with it, without pushing it forward, and imparting so much of its *motion*, which being added to that which was in E before, makes both their *motions* to be equal. So that if A hath six degrees of *Swiftness*, and E but four; let the two degrees whereby A exceeds E, be divided into four Parts, and then let one part be communicated to E: But because thus the *motion* of A is still *swifter* than that of E, let the second also be communicated. And seeing that upon the Communication of these two Fourths, the *motion* of the *Body* E, is made as swift as that of the *Body* A, it will not be able to receive any farther increase from A, and therefore will retain the remaining two Fourths; and so both of them, with the same swiftness, that is, with five degrees of *swiftness*, will move towards the *Right* hand.

XI. *The Fourth Rule.*

But if the Body E *be wholly at Rest, and somewhat bigger than* A, *then with whatsoever swiftness* A *may be supposed to move towards* E, *it will never be able to move it, but will be beaten back by it, still retaining its motion entire.* For a *Body* at *Rest* doth more resist a greater degree of *Swiftness* than a less, and that according to the degree of the Excess of the one above the other; and consequently there will always be a greater force in E to resist, than in A to push forwards. For a Body *at Rest*, doth as much as in it lies continue in its *Rest*, and must by some outward force be driven out of its place, before it can tend any way. Wherefore such a *Body* doth not only, with all its Parts joyn'd together, resist the *motion*; but also proportionably to its *bulk*, whereby it exceeds other *Bodies*, it is made more strong to withstand others that oppose it. And therefore the *Body* E, because of its greater Bulk, hath a greater Force to resist, than A hath to move. By which means it comes to pass, that it is not changed by A, but with the same Force continues in *Rest*, wherewith the whole *Body* A will be moved, and dash against it.

XII. *A Body that is at Rest, doth more resist a greater Swiftness than a less.*

Now, that a *Body* at *Rest* doth more withstand a greater degree of *Swiftness*, than a less, and that according to the excess of the one above the other, is demonstrable from the most common Law of *Nature*; that *every thing, forasmuch as it is simple and undivided, continues (as far as in it lies) always in the same State, neither is ever changed but by outward Causes.* Now the state of the *Body* E, is *Rest*, and in the swifter *Body* A, the state is quite contrary, and that proportionably to the Excess of *swiftness*. For the slower the *motion* of A is, the less contrary is it to the state of the *Body* E, which is at *Rest*, because slowness of *motion* partakes of the Nature of *Rest*. Wherefore, if A with the greatest degree of *swiftness* be carried towards E, *Resting*, E will also have an absolute power of Resisting; and forasmuch as it resists, it will with a greater force of Action, resist the greater force that pusheth it, than a lesser.

XIII. *The Fifth Rule.*

If the Body at Rest E, *be less than* A, *then tho' A move never so slowly towards* E, *it will carry it along, and communicate to it such a part of its motion,*

motion, as that both of them afterwards may move with the same swiftness. As for Example, If A be as big again as E, it will communicate to E the *Third part* of its *motion*, because that one Third part will move E, as swiftly as the Two remaining parts will move A, because it is as big again. And since whatsoever accrues to the one, is the loss of the other, it is necessary that after this meeting A move one Third part slower, than it did at first, that is, in the same time wherein before it run through the distance of *three Foot*, it will only move *two Foot*.

In like manner, if A were *thrice* as big as E, it would communicate the Fourth part of its *motion* to it. If it were *four times* bigger, it would impart a Fifth part of its *motion*; and so on. But if A should only a Third part exceed E, and consequently should have the Relation to it, not of Two to One, but of Three to Two, then two *fifth parts* of the *motion* will be transferr'd from A to E, and three *Fifths* will still continue in A. If E be one *Fourth* bigger, and have the same Relation to A, as Four to Three, three Seventh parts of its *motion* will be communicated to E, and so four Seventh parts will remain to A.

This account will be more evident, if we express the foresaid Fractions by whole Numbers: Saying, if A be to B, as 3 to 2, then of the *five* degrees, into which its *motion* may be distinguish'd, two must be communicated, which will have the same proportion to E, as the three remaining to A: And if A be as 4, and E as 3, out of the seven degrees of its *motion*, *three* must be communicated, which will have the same proportion to E, as the remaining 4 to A. And if A be to E as 5 to 4, of the 9 degrees into which its *motion* may be distinguish'd, 4 will be communicated, and will have the same Proportion to E, which the Five remaining have to A. And thus we may proceed to Infinity; for tho' the excess of *Quantity* in A, above *that* which is consider'd in E, does by this means grow less, yet it will always be something; and since we may always take so many degrees of *motion*, as there are parts considered in the *Body moving* and *moved*, taken together, we find no Reason why A should move E along with it, seeing the difference is of one Sixth, Seventh, Eighth, or even of a Hundredth or Thousandth part, and so on.

The account will proceed in the same manner, whether you reckon the *Parts* of *Motion* to be so many, as there are consider'd in the Bulk of both *Bodies*, *viz.* the *Moving* and *Moved*, or whether you attribute two, or three, or four Parts or Degrees, and so on, of *motion*, to every one of the *Parts* of *Bodies*; because the same Proportion will continue every where between the *Motion* that is communicated, and that which continues in the *Mover*. Thus we may say, that if A be one Third bigger than E, of the 10 parts into which its *motion* may be distinguish'd, 4 will be transmitted to E, the remaining 6 continuing with A: Or, if we suppose 15 parts of *Motion*, then 6 will be communicated and 9 will remain; if 20, the *Body* E being a Third part less than A, will receive 8 of them, and A will retain the other 12. For all these Numbers, 12 to 8, 9 to 6, 6 to 4, have the same Proportion together which they ought to have, which is 3 to 2; and therefore it is all one which of them you take, and you may increase them to Infinity. And how slow soever you suppose the *motion* in A to be, it will still in the same proportion act upon E, that is, will always communicate to it only such a *part* of its *metion* as shall bear the same proportion to E, as the remaining part hath to A. And thus, if A be as big again, whether it be swiftly or slowly *moved*, it shall always transfer a Third part of its *motion* upon E; if thrice as big, only a Fourth, and so on.

XIV. *The Sixth Rule.*

If the Body E, *Resting, be exactly equal to the Body* A, *moved towards it, it will partly be push'd forward by it, and partly beat it back to the opposite side.* So that if A should come towards E, with four degrees of Swiftness, it would communicate to E one degree, and with the three remaining parts would rebound to the contrary side.

For seeing that both these *Bodies* are supposed of *equal bigness*, they must also have the self same Force of *Acting* and *Resisting*: Now this Force to Resist in E, is not only *Negative*, but *Positive*, or, if you will, *Reactive*; because E so admits the *motion* of the Agent A, as to cause some change in it, to wit, by *Reflecting* it, and communicating some part of its own *Rest* unto it. And by this means the *Body* E obtains the half of its effect. But the *Body* A, because of its inequality, transfers a part of its *motion* to E, not the whole; for so it would tend to its own destruction, by losing all its *motion*. Thus if the *Body* A should move towards E with four degrees, in meeting with the *Body* E, it would impart one degree to it, and would rebound back with the three remaining parts. If with eight degrees, it would impart two of them to the *Body* E, and rebound with the other six. If it mov'd forwards with twenty degrees, it would communicate five of them to E, and fly back with the remaining fifteen, and so both would obtain the half of that effect, the whole of which they would have, if either of them were greater or less.

XV. *The Seventh Rule.*

Suppose we now the Bodies A *and* E, *to move the same way,* E *more slowly, and* A *following it more swiftly, so as at last to overtake and touch it: Suppose we also* E *to be greater than* A, *but* A *to exceed in degrees of swiftness the Greatness of* E; *in this case* A *will communicate so much of its Motion, as that both of them afterwards shall move with an equal degree of swiftness the same way.*

That A must overtake E, appears from the Supposition of its being mov'd more swiftly than E; and that it must act upon it, and push it on along with it self, is also evident, because upon examining the proportion of *Magnitude* and *Swiftness* that is between them, we find that the Excess of *swiftness* is greater in A, than the Excess of *Greatness* in E; and therefore by reason of the inequality of *Action* and *Resistance*, it must follow that A, by communicating some part of its *motion* to E, must push it forwards; and so both of them with the same *swiftness* move the same way.

XVI. *The Eighth Rule.*

But *if the Excess of Swiftness be less in* A, *than the Excess of Greatness in* E, *it will rebound back, and retain all its motion.* The Reason is, because that which is the stronger in *Action* and *Resistance*, must needs obtain its effect. Now seeing

the *Body* E, by its Greatness or Bulk, exceeds the swiftness of A, and has more force to *Act* and *Resist*, it must push forwards the *Body* A, and make it rebound backwards. But forasmuch as every thing inclines to continue in its state, except it be hindred by an outward *Cause*, and this *Cause* is found in E, *viz.* an Excess of *Magnitude*, above the Excess of *Swiftness* in A, which changeth the *determination* of A, but doth not destroy or diminish the *Motion* it self, therefore it happens that A, by rebounding, loseth nothing at all of its own *motion*.

But if the Excess of *Bulk* be greater in E, than the Excess of *Swiftness* in A; that is, if E be as big again as A, and yet A be not moved with a double degree of *swiftness*; then when A comes to dash against E, it will reflect the contrary way, without communicating any thing of its *motion*. Lastly, if the *Body* E doth equally exceed A in Bigness, and that it be as big again, which is just as much as A exceeds E in *swiftness*, and therefore hath a *motion*, that is, as swift again, it will follow that A must communicate some part of that its swifter *motion* to E, and with the residue rebound back from it.

CHAP. VIII.

Of the Ptolomaick, Copernican, and Tychonick Systems of the World.

I. *What a System is, and how many there are.*

A *System* in *Natural Philosophy* is that, whereby a thing *acts* after a certain manner, by virtue of its *Composition*, and those Dispositions which constitute its *Nature*. Thus we call the *System of the World*, the Order or Disposition wherein we conceive, that all we see in the *World* is performed, by supposing it to be compos'd of certain *Parts*, the Nature and Connexion whereof is such, that thence results whatsoever is, or is done in it. Amongst the *Systems* of the *World*, invented by *Astronomers*, there are Three more famous than the rest, *viz.* those of *Ptolomy*, *Copernicus*, and *Tycho Brahe*, to which all the rest that have been invented by the *Ancients* may be referr'd.

II. *The Ptolomaick System.*

Figure 16.

PTOLOMY placeth the *Globe* of *Earth* and *Water* in the *Center* of the *World*, and supposeth it destitute of all *motion*. Next to the *Earth*, he placeth the *Air* mingled with *Vapours* and *Exhalations*, which raising it self only a few Miles above the *Earth*, is called the *Atmosphere*. Next below the *Moon* he placeth his Element of *Fire*; the several Spaces above which he divides into *Eleven Spheres*, in the first Seven whereof he ranks the *Planets*: In the first ☽, the *Moon*; in the second ☿, *Mercury*; in the third ♀, *Venus*; in the fourth ☉, the *Sun*; in the fifth ♂, *Mars*; in the sixth ♃, *Jupiter*; in the seventh ♄, *Saturn*; which he calls *Wandring Stars*: Not that they wander at Random; but because they are carried with an *unequal motion* within the *Zodiack*, so as not to keep the same Distance from one another, if compar'd with the *fix'd Stars*. In the *Eighth Sphere* he placeth the *Firmament*, in which the *fix'd Stars* are supposed to be fastned.

After these follow two other *Spheres*, which he calls *Crystalline*, or the Heavens of *Libration* and *Trepidation*; the first Moving from the *East* to the *West*, the other from the *North* to the *South*. The Eleventh and highest *Sphere* he calls the *Primum Mobile*, or *First moved*. This Description of the *World* is by the Common People generally approved and maintain'd; who look upon the *Heaven* as a *Vaulted Roof*, equally distant from us, who are as in the *Center* and suppose all the *Stars* that appear in it, to be in the said Circumference of the *World*.

III. *The System of* Copernicus.

NICOLAUS COPERNICUS, a *Physician* of *Thorn*, and Canon of *Frassenburg*, who flourish'd not much above an hundred years since, introduced another *System* in Imitation of the *Pythagoreans*, who attributed a *motion* to the *Earth*, and plac'd the *Sun* as the *Soul* of the *World*, in the *Center* of it; and consequently assigns the same place to the *Earth*, which *Ptolomy* allows the *Sun*, that is, betwixt the Planets *Venus* and *Mars*. The *Earth*, according to *Copernicus*, hath two *motions*; the one *Diurnal*, which in 24 Hours space is performed about its own *Axis*, from *West* to *East*; which Motion makes *Days* and *Nights*, as shall be said hereafter. And this *Motion* performs the same Service, which the *Primum mobile* doth in the *Ptolomaick System*, to wit, by effecting that all the *Stars* seem to move from *East* to *West*; much in the same manner as a *Ship*, which sailing from the *Shoar*, or towards it, makes the Shoar it self seem, as if it drew near, or withdrew from the *Ship*. The other *Motion* of the *Earth*, is its *Annual motion*, by which she is carried about the *Sun*, from the *West* also to the *East*, according to the Succession of the *Signs* of the *Zodiack*; by which means, the *Sun* which stands immovable in the *Center* of the *World*, doth seem to run through those *Signs*, tho' indeed it is the *Earth* only that truly doth so. And whereas the Space that is between *Mars* and *Venus*, is large enough for the *Moon* to be carried round between them, she accordingly performs there two *Motions*, the one *Monthly*, wherewith she is whirl'd about the *Center* of the *Earth*, and appears in her several *Changes*; the other *Yearly*, whereby (together with the *Earth*) she goes round the *Sun*.

Figure 17.

Wherefore, according to the *Copernican System*, the *Sun* is placed in the *Center* of the *World* immovable. Tho' this hinders not, but that it may be carried round about its own *Axis* within the space of 27 days, which that it is, appears by the turning round of its *Spots*, discovered by the *Telescope*. Next to the *Sun*, *Mercury* is whirl'd about; in the second place, *Venus*; in the third, the *Earth*, together with the *Moon* its Attendant; in the fourth, *Mars*; in the fifth, *Jupiter*; and in the last, *Saturn*. After which follows the Region of the *fix'd Stars*, so called, not because they are without all *motion*, but because they do not wander up and down like the *Planets*, but continue in their own places, and keep the same distance from one another, as will be shewed in the XX*th Chapter* of this *Part*.

IV. *The System of* Tycho Brahe.

Figure 18.

Besides these two *Systems*, a Third hath been contrived by *TYCHO BRAHE*, which partakes of both the foregoing *Systems*. For as to the Digestion of the *Parts* of the *World*, it agrees with the *Copernican*, save only in this, that it constitutes the *Earth* to be the *Center* of the *Firmament*, and accordingly makes the *Moon* and *Sun* to run round it. Thus in explaining the seeming *motion* of the *Heaven*, which seems to be performed in

in 24 Hours, he follows *Ptolomy*, and supposeth the *Earth* to stand immoved in the *Center*, and the whole *Heaven* to be carried round it, from *East* to *West*, by the Force of the *Primum Mobile*. But in explaining the Appearances of the *Planets*, he agrees with *Copernicus*; making *Mercury* and *Venus* to be carried round nearest to the *Sun*, as their *Center*; but *Mars*, *Jupiter* and *Saturn* at a farther distance; and in the middle Space placeth the *Earth*, with the *Moon* that is carried round her, in the same time that *Copernicus* assigns to it. The *Tychonick System* has this peculiar to it self, that the *Planets*, which perform their own *motions* about the *Sun*, are whirl'd about by it, so as that *Mercury* and *Venue*, in their Turnings round about the *Sun*, do never take in the *Earth*, as *Mars*, *Jupiter*, and *Saturn* do. So that as *Gassendus* observes, if instead of the *Sun*'s whirling about together with *Mercury* and *Venus*, who exclude the *Earth* from the compass they take, and with *Mars*, *Jupiter* and *Saturn* enclosing it, the *Earth* had been supposed to be whirl'd about with the *Moon*, comprehending in its compass *Venus* and *Mercury*, but comprehended within the compass of *Mars*, *Jupiter* and *Saturn*, it would come to the same thing; and *Tycho's System* would appear to be nothing else but the *Copernican* inverted.

V. *Ptolomy's System rejected.*

Having given this brief Description of these three *Systems*, we are next to examine which of them appears the *Truest*. For seeing that they all differ, and that the Structure or Disposition of the *Parts* of the *World* is but one only, we must reject two of them as *false*, and choose the third as the *truest*. And tho' we should suppose nothing of Contradiction to be found in any of these *Three*, yet ought we to pitch upon that as the *best*, which appears the most *simple*, and supposeth least *particulars*.

VI. *Many things are amiss in the Ptolomaick System, as being contrary to Experience.*

Wherefore we cannot admit of the *Ptolomaick System*, as being contrary both to *Reason* and *Experience*: To *Experience* first, with regard to the appearances of *Venus* and *Mercury*, seeing it is evident that these *Planets* are not always whirl'd about on this side of the *Sun*, as *Ptolomy* supposeth, but sometimes appear above, and sometimes beneath, yea, and sometimes also side-ways to it; so as that sometimes they are nearer to, and at other times they are further from us than the *Sun*. For this Cause *Copernicus* took occasion from the various appearance of *Mars*, to assign *motion* to the *Earth*. For he perceiving that *Mars*, whilst he is opposite to the *Sun*, appears much greater; and that he grows less, as he nearer approacheth to it, could not attribute this change to any thing better, than to the *Circumrotation* of the *Earth*: According to which, it was necessary for *Mars* to appear biggest, when the *Earth* moves neareſt to him; and least, when the *Earth* leaves him on the other side of the *Sun*.

Secondly, Pursuant to this *System*, no Reason can be given why *Mars*, *Jupiter* and *Saturn* are always in the lower part of their *Epicycles*, when they are *Retrograde*. Whence it is that the *Moon* doth always turn the same part of her Body towards us: Why *Saturn* appears in a various shape to us, sometimes *Oval*, and at others *Round*, when beheld through a *Prospective*.

Thirdy, This *Hypothesis* doth not explain the *contrary Motions*, whereby the *Stars* at the same time seem to move from *East* to *West*, and from *West* to *East*.

Fourthly, Neither can the rise of *Comets*, nor their *motions*, be solved, as long as we suppose the *Heavens* to be solid, as he doth.

Fifthly, According to this *Hypothesis* we cannot give any account, how the *Spots* about the *Sun* are generated, and afterwards dissipated; nor how they can perform their *Circuits* about the *Sun*.

VII. *This Hypothesis is likewise contrary to Reason.*

This *System* is also contrary to *Reason*, by allowing the *motions* of *Trepidation* and *Libration* to the *Crystalline Heavens*. For what is more misbecoming a *Philosopher*, than for the extricating of a lesser Change, to admit a far greater? For a *Body* that is carried towards one *Point*, tho' by an uneven *motion*, questionless doth not undergo so great a Change, as another, which is also carried towards one *Point*, and suddenly rebounds to the opposite Point. To this may be added, that it was in vain that the *Ancients* had recourse to this *motion*, for the explaining of the Equal progress of the *fix'd Stars*; since the most exact *Astronomers* frequently Experience, that what they deduce thence by their *Computations*, doth not correspond with the *Phænomena*. Besides, the *Motion* of the *Heavenly Orbs* will be swifter than can be competent to such vast *Bodies*, and more especially to the Brittle *Crystalline Spheres*; for the utmost *Sphere* of the *World* must be whirl'd about in 24 *Hours*. Moreover, what is more improbable than that the *Primum Mobile* should have the force to carry round with it all the *Inferiour Orbs*, from *East* to *West*; and yet that the *Earth*, which is included in them, should remain unmov'd? When yet, according to *Ptolomy*, the *Earth* is altogether Passive, and is encompass'd with the *subtil Matter*. These Absurdities are sufficient to make us reject this *Ptolomaick Hypothesis*.

VIII. *The Tychonick System also hath its Errors.*

Tho' the *Tychonick Hypothesis* seem more probable than the *Ptolomaick*, forasmuch as it gives an account of the Inequality and Diversity of the *Cœlestial Appearances*, yet is it not without its obscurity and defects. For it seems in a manner to disjoynt the whole *System* of the *World*, forasmuch as whilst the *Sun* (the *Center* of Five of the *Planets*) whirls about the *Earth* in its *Annual motion*, this his *Annual motion* is entangled with the proper *motions* of the several *Planets*; for the explaining whereof he is fain to make use of a *Circle*, described from the *Suns Center* with two *Epicycles*; whereas the structure of the *World*, is without doubt very far from any intricacy or confusion, and allows every *Planet* a sufficient Space to run its Course in.

IX. *And is to be rejected, as well as the Ptolomaick.*

Besides, this *System* hath several other *Defects* for which it is to be rejected, as well as the *Ptolomaick*. For tho' it admits of less *Suppositions* for explication of the *Motion* of the *Planets*, and gives a plausible account of the *Appearances* of *Venus*; yet it cannot be deny'd, but that it requireth something, which the Mind of *Man* can hardly assent to, in that it supposeth that *Motion*, whereby the Mass, consisting of the *Heavens* and *Planets*, in *Twelve Months* time, moves towards all parts of the *Firmament*. For tho' we should admit, that it had been put into such a *motion* by the Author of *Nature*, at the beginning of the *Creation*; yet withal

withal we must suppose, that according to the *Laws* of *Nature*, which GOD himself hath established, the said *Motion*, in success of *Time*, must be diminished, and at last cease altogether; since (according to the same) it must have been communicated to the *Heavenly matter*, which the foresaid *Mass*, to which *BRAHE* assigns this *Motion*, drives from those Parts to which it tends.

X. *The Copernican System is to be preferr'd before the two former.* It remains therefore, that we only admit of the *Copernican System*, as being both more plain and simple than the two foregoing, and solving the *Phænomena* of the *Heaven* the best of the three. But forasmuch as *Des Cartes* professeth himself to dissent from *COPERNICUS* and *TYCHO* as to the *Motion* of the *Earth*, which he denies with more *Truth* than *TYCHO*, and with more *curiosity* than *COPERNICUS*, we intend last of all to propound his *Scheme*, as the only true one.

CHAP. IX.

Of the true Systeme of the Universe.

I. *The Copernico-Cartesian Hypothesis explained.* *DES Cartes* supposeth that *Matter* indefinitely extended, and by *motion* impresst upon it, divided into various *Particles*, did run together into several *Vortexes* or Whirl-Pools, whirling about some certain Points with a most swift *motion*; that the more subtil matter gathered together about the *Center* of these *Vortices*, constitutes the *fixt Star*; that the *matter* which is a degree bigger, makes the *Heavens*; and that the more solid *Bodies* (such as is the *Earth* and the rest of the *Planets*) hanging poisd in this fluid *matter*, comply with the *motion* of the *Vortex* about the *fixt Star*, and may over and above this, be whirld about their own *Axis*; as we often see that *Bodies*, carried in a fluid Stream, are turn'd round by a *motion* of their own, that is, proper to themselves, and not derived from the Stream wherein they are carried.

Figure 19.

II. *The first Heaven.* Moreover *Des Cartes* divides all the *Vortexes*, that compose this *World* into two *Heavens*. In the first, he supposeth all the Matter of *Heaven* in which the *Planets* move, to run round continually in manner of a great *Vortex*, or mass of fluid Matter whirling round, in the *Center* whereof is the *Sun*, S, and that those *Parts* that are nearer to the *Sun*, move more swiftly, than those that are more remote, and that all the *Planets* (of whose number also the *Earth* T is,) have their course continually amidst the Parts of that *Cælestial* Matter.

III. *The second Heaven.* The second *Heaven* comprehends an immense number of other *Vortexes*, which surround this *Vortex* or first *Heaven* A, B, C, which in their *Centers* have the several *fixt Stars*. And because we are uncertain at how great a distance the *fixt Stars* are from us, and cannot conceive them so remote as to contradict the *Phænomena*, we will not content our selves with placing them above *Saturn*, but will take the liberty to conceive them much higher; seeing that it is apparent from the *Cælestial motions*, that they are so far distant from us, that *Saturn* compar'd to them, seems to be very near us. *Des Cartes* to illustrate the Truth the more about the motion of the *Planets*, and especially of the *Comets*, made no difficulty to assign an immense distance between *Saturn* and the *fixt Stars*.

IV. *The distance of the fixt Stars from the Sun.* Neither is this in the least contrary to Reason, forasmuch as we know that *Mercury* is above two hundred *Diameters* of the *Earth* distant from the *Sun*; *Venus* above Four hundred; *Mars* Nine hundred or a Thousand; *Jupiter* above Three thousand, and *Saturn* Five or Six thousand. And proportionably we may extend the Space between *Saturn* and the *fixt Stars*, to any distance how vast soever. For tho the *Region of the fixt Stars*, be commonly reputed the utmost Bounds of the *World*, yet its *Figure* cannot be certainly determined by us, seeing we can perceive nothing of its *Internal* nor *External Superficies*.

V. *Saturn is the First of the Planets.* The first of the *Planets* and neerest to the *fix'd Stars* is *Saturn*, who sometimes appears as if he had three *Bodies*, sometimes *Long* or *Tall*, sometimes *Sphærical*, sometimes *Oval*, with *Ears* and *Ear-rings*. For tho' *Saturn* like the other *Stars*, be of a Round *Figure*, yet is he surrounded with a broad *Circle* or *Ring*; standing at an equal distance from him; the proportion of the *Semidiameter* of the *Planet*, being to the distance of the Ring, as 3 to 5: but the entire *Diameter* of the *Ring*, to that of *Saturn* is about the proportion of 11 to 5. The *Ring* is thin, but broad, and if continued, would pass through the *Center* of *Saturn*. This *Planet* being most remote from the *Sun*, the *Center* of this our *World*, and being moved in a large *Vortex*, is almost 30 years in finishing his *Circuit* in our *Heaven* A B C.

VI. *Saturns three Satellites.* Three *Satellites* or *Guards*, are observed to move about him, the *First* whereof is distant from the *Center* of *Saturn*, one *Diameter* of the foresaid *Ring*, and performs his Circuit about *Saturn* in the Space of 4 *days*, 12 *hours and* 27 *minutes*. He is seen through a *Telescope* of 35 Foot, in his furthest digression from *Saturn*, but is imperceptible when nearer to him. The *Second* is much more illustrious, and may be descried by any moderate *Telescope*, and is distant from *Saturn* four Diameters of the said *Ring*, and whirls round him in the time of 16 *days* and 23 *hours*. The *Third* is distant from him 10 *Diameters* of the *Ring*, and performs his Circumvolution in the Space of about 80 *days*.

VII. *The Second is Jupiter.* The next to *Saturn* is *Jupiter*, who absolves his Course in almost 12 years. He hath four less *Planets*, as so many little *Moons* to be his Companions, to which *GALILÆUS* gave the name of the *Medicæan Stars*, because he first discovered them in the Dominions of the Duke of *Florence*. Their special names are, the *Jovial Saturn*, *Europa*, *Ganymedes*, *Calisto*; whereof the *First* or remotest wheels about *Jupiter* in 16 days; the *Second* in 7 *Days*; the *Third* in 85 hours, and the *Fourth* in 42 hours.

VIII. *The Third is Mars.* The Third Planet *Mars* is carried about a in greater *Vortex* than the *Earth*, and in a less than *Jupiter*; and finisheth his Revolution in near two years. In the midst of this Planet *CAMPANELLA* by the help of Prospectives discovered a Black *Mountain*, higher than the Mountains of the *Moon*: From whence, as likewise from the *Spots*, wherewith his *Face* is sprinkled, *CASSINUS* gathered, that *Mars* was whirld about his own *Center* in the Space of 24 *hours* and 49 *minutes*. There is also a round *Ring* somewhat resembling a *Rainbow*, but of a Redder Colour, which surrounds the Foot of that *Mountain*.

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IX. *The Fourth is the Earth.* The fourth place is taken up by the *Earth*, which absolves its Course together with the *Moon*, (which she carries about in her *Vortex*) within the Space of a Natural year. All the Matter that reacheth from the *Earth* to the Moon, is called *Elementary Matter*; and because this Matter contains many parts, which are moved more swiftly than the *Rest*, it follows that they must all of them be unequally determined to recede from the *Center* of their Motion, and that those which are more swiftly moved, withdrawing themselves with greater force, do by this means thrust the other parts downwards: Which is the cause of Gravitation, as hath been said before.

X. *The Earth is not placed in the Center of the World.* Now that the *Earth* is not placed in the *Center* of the *World*, but rather is as far distant from the *Center*, as from the *Sun*, appears from hence; that all the *Planets* are sometimes nearer, and at other times farther from the *Earth*; and that with such a vast difference, that *Venus* when she is farthest from us, is at a six-fold greater distance, than when she is neareſt; and *Mars* is eight times farther distant in the one State, than in the other, which could never be, if the *Earth* were the *Center* of the *World*.

XI. *The Fifth is Venus.* The Fifth is *Venus*, who runs her course in 224 *days*. She is carried below the *Earth*, surrounding the *Sun*, which may be concluded from the changes of her *Figure* and appearance, proceeding from the Illumination thereof.

XII. *The Sixth is Mercury.* Next to *Venus* is *Mercury*, finishing his Course about the *Sun* S in the Space of 80 *days*, or as others will have it in 87. He very rarely appears, being for the most part obscur'd by the *Suns* Rayes. Hence *GALILÆUS* conceives, that *Saturn* for his slowness, and *Mercury*, for his almost continual occultation, ought to be accounted the last of the *Planets*. Now forasmuch as *Mercury* doth not appear, but in his farthest Elongation from the *Sun*; he is seldom seen *Round* through a *Telescope*; but sometimes as it were *cut in two*, as the *Moon* in her Quarters, sometimes more Gibbous, and at other times hollow; and being neareſt unto the *Horizon*, and obscur'd by Vapours, its *Figure* or *Bulk* can scarcely be discovered.

XIII. *The Sun is the Center of the whole compass of the Heavenly Matter.* In the midst of this great *Vortex* the *Sun* is placed, as in the *Center* of the *World* unmoved, and like a Prince seated in his Royal Throne, Illustrating all the *Bodies* about him, both Cherishing, and Quickning them with his *Heat*. *TRISMEGISTUS* calls him the *Visible God*, and *SOPHOCLES* gives him the Epithet of *Beholding all things*. But notwithstanding what we have said of his being unmoved, he may whirl about his own *Axis*, in the of Space of 24 *days*, which *Astronomers* conclude from the most constant Motion of its *Spots*.

XIV. *All the Planets are moved from West to East.* Tho' all the *Planets* with regard to their different Degrees of Solidity be unequally distant from the *Sun*, the *Center* of our *Vortex*, A, B, C; yet is this common to them all, that they perform their *Periodical Motions* after the same manner, *viz.* from *West* to *East*, or from A, through B, towards C, according to the succession of the *Signs* of the *Zodiack*. Save only that the *Earth* is carried with a threefold *Motion*, and as the chiefest *Star* amongst the *Planets*, hath the *Moon* for her Attendant: So that the *Vortex*, which hath the *Earth* for its *Center*, carries the *Moon* about the *Earth* in a Months Space, the *Earth* it self being whirld about every day, round its own *Axis*. Thus in the same time, that the *Earth* and *Moon* finish their Common Circle, or Great *Orb* once, the *Earth* is 665 times whirld about its own *Axis*, and the *Moon* twelve times carried about the *Earth*.

XV. *An Objection answerd.* The Common Objection against this *Hypothesis* is, that the *Horizon* in all parts of the *World*, divides all the great *Circles* into equal *Parts*, so that always one half of the *Equinoctial* is above it, and the other half under it, and consequently always 6 Signs of the *Zodiack* above the *Horizon* and as many under it; whence it must follow, that the *Earth* is in the *Center* of the *World*, and not the *Sun*.

To which I answer, that this proves indeed, that the *Earth* is in the midst of all the *great Circles* of the *Sphere*, but not that she is in the *Center* of the *World*, because it is our Imagination only, that represents these *Circles* about the *Earth*. Accordingly it would be a false consequence to say, that the *Earth* is in the *Center* of the *World*, because the *Parts* and *Degrees* of the *Earth*, do correspond proportionably to the *Parts* and *Degrees* of *Heaven*; for on the contrary it follows that these *Circles* are equally distant and proportional in their *Parts*, with regard to the *Earth*, seeing that it is our Imagination which conceives them round its *Center*.

XVI. *The Planets may more properly be said to Rest in their Vortex than to be moved.* Notwithstanding the *Earth* and all the other *Planets* be carried by the *Celestial matter* that surrounds them from *West* to *East*, yet they may more properly be said to *Rest* than to *move*. For seeing that *Local motion* is nothing else but *the Translation of one Body, from the Neighbourhood of those Bodies, which immediately touch it, and are considered as immoveable, into the Neighbourhood of other Bodies*, and that neither the *Earth*, nor any of the other *Planets*, are translated from the Neighbourhood of those parts of *Heaven* that immediately touch it, and are lookt upon as immoveable, the *Earth* and *Planets* acording to the Truth of the thing are not moved, that is, have no motion properly so called.

XVII. *Neither the Diurnal nor Annual Motion do properly belong to the Earth.* Yea, if we give head to the Definition of *motion* we shall easily discern, that that which we call the *Diurnal motion* doth not belong to the *Earth*, by it self considered, but as it is an Aggregate of *Earth*, *Seas* and *Air*, seeing it is to be lookt upon at altogether at *Rest*, whilst it is whirld about by the stream of the *Heavenly matter* wherein it swims; like as a Man who sleeps in a *Ship*, is said to *Rest*, whilst the *Ship* is carried from one place to another. We shall also perceive, that the *Annual motion* of the *Earth*, whereby it is carried about the *Sun* from *West* to *East*, through the *Signs* of the *Zodiack*, cannot be ascribed to her, but to the *Cælestial matter*, which carries this vast Mass round the *Sun*.

XVIII. *The Orbs of the Planets are not exactly Circular.* Moreover we are to mind that the *Circuits* the *Planets* make about the *Sun*, are not perfectly *Circular*: For as we see that in some parts of *Rivers*, where the *Water* whirling about, makes a *Vortex*, and carry many Straws along with it, some of them at the same time are whirld round about their own *Centers*, and are moved more swiftly as they are nearer to the *Center*; and tho' they incline to move Circularly, yet do not always describe exact *Circles*;

cles; so we may without difficulty imagine all the same things concerning the *Planets*. As is manifest from their nearer and further distances from the *Sun*, and from their Descent and Ascent in the *Zodiack*, being sometimes above the *Ecliptical Line*, and at other times under it.

CHAP. X.

That the Heavens are Fluid Bodies.

I. *It is no difficult matter to know the Nature of the Heavens.*

IT will not be difficult to have a certain knowledge of the Nature of the *Heavens*, if we consider that the *Matter* whereof they consist, is the same with that of the *Inferiour World*, nothing being to be found in it besides *Divisions*, *Figures*, *Magnitudes and Motions*. Which Modifications, wheresoever they are, still cause the same changes. And therefore we are to *Philosophize* concerning the *Heavens* no otherwise, than of our *Bodies* here below.

II. *The distinction of Hard and Fluid Bodies.*

We are therefore to suppose that *Bodies* are either *Hard* or *Fluid*. *Hard* are those whose parts are so joyned, as not to be separable from one another without difficulty. Whereas *Fluid* are such whose Parts do readily give way: But how it comes to pass, that some *Bodies* do easily give way to others, and that others are not removed from their places without Force and Difficulty, we shall easily apprehend, if we consider, that these things which are moved, do not hinder other *Bodies* from entring their places; whereas those that are at *Rest*, are not without some force pusht out of them.

III. *The Parts of Hard Bodies are at Rest, and those of Fluid, in motion.*

Whence it follows, that those *Bodies* are *Fluid* whose parts are tossed with various *Motions*; and those *Hard*, whose *Parts* being closely joyned together are at *Rest*. And tho' it may be our Sense may not perceive the parts of *Fluid Bodies* to be moved, yet are not we therefore to deny it; because we see the *Water* and *Air* do corrupt solid *Bodies*, which cannot be done without *Motion*.

IV. *The Heavens are no Solid or Hard Bodies.*

We say therefore, that the *Heavens* are no *Hard* or *Solid Bodies*, but *Fluid*. For if they were *Hard*, they could not transmit the *Light* of the *Stars*: For *Hard* and *Diaphanous Bodies*, transmit the *Light* because their Pores are rang'd in *Right Lines*, which could never be, if the vast Bulk of the *Heavens* was *Solid* like *Crystal*, or did much infringe the Light, as we see, that when many pieces of the cleerest *Glass*, are laid one upon one another, they become very opake.

V. *Supposing that the Heavens were Solid, the superior Spheres, could not carry the inferior along with them.*

If the *Heavens* were *Hard*, we could never explain how the Lower *Heaven* should be snatch'd along by the *Heaven* above it; as the *Peripatetick*s imagin. For how can the *Heavenly Orbs*, supposed polisht and even, hurry away with their *Motion* the *Spheres* that are under them? Yea when the *Sun* and the rest of the *Planets*, are whirld about round their *Center*, as hereafter shall be declared, no reason can be assign'd, why they should not as well be carried in the Liquid *Æther*. And indeed all the Antient *Philosophers*, before *ARISTOTLE*, were of Opinion that the *Stars* moved in the *Heavens* like *Fishes* in the *Sea*. And *Astronomers* are of the same Mind, who have observed that *Mercury* and *Venus* have sometimes got above *Mars*, and come down again, which could never be if the *Heavens* they move in were Solid.

The same may be evinced by the *Comets* which are found to be above the *Region* of the *Moon*, and to slide through those *Æthereal Spaces*, which could not be without those Spaces were filled with a *Fluid Body*. The *Astronomers* have also observed, that the *Medicæan Stars*, do roul about *Jupiter*, as *Venus* about the *Sun*, which likewise proves the Fluidity of the *Heavens*.

VI. *The Motion of the Comets and Stars, is a pregnant proof of the Fluidity of the Heavens.*

Neither only are those *Heavens Fluid*, which contain *Mercury*, *Venus*, *Mars*, *Jupiter*, *Saturn*, and our *Earth*, together with the *Moon* its Companion, but the *Matter* of the *Sun* it self is also Fluid, and is continually whirld about its own *Axis*, as is evidenced from the *Motion* of the *Spots* about the *Body* of the *Sun*; for they are not generated in the *Air*, as some have supposed, but in the very *Body* of the *Sun*. For at *first* they are seen in the midst of the *Suns Body*, and near to his *Ecliptick*, and never towards the *Poles* of the *Solar Body*. This is confirmed by many *Astronomers*, who at great distances of *Place*, have observed the very same *Spots*, at the same time, and in the same places. Now that the *Sun* doth not only move these *Spots*, but also the *Planets* that are about him, appears from hence, that the nearer any *Planet* is to the *Body* of the *Sun*, the swifter it is turnd about. And the same is to be conceived concerning that vast Space, which is found about every *fixt Star*.

VII. *The Fluidity of the Heaven proved by the Spots of the Sun.*

But you'l say *first*, that the *fixt Stars* observe the same distance from one another, which could not be if they wanderd in a *Fluid Heaven*, changing their places, as is evident concerning the *Planets*, who oft enter one anothers *Orbs*. I answer, that the equal distance the *Stars* keep, doth not prove the *Solidity* of the *Heavens*, but that they possess some determinate *Orbs*. For the *fixt Stars* are not placed in the Circumference of one *Sphere* as some imagin, but every one of them hath its own *Space* or *Orb*; and because they observe the same Order and Propotion amongst themselves, therefore are they called *Fixed*.

VIII. *How the fixt Stars keep the same distance from one another.*

In the *Second* place you'l say, If we suppose the *Heavens* to be *Fluid*, it cannot be conceived how *Solid Bodies* can be carried about in them, seeing that they have not so much Power, but do readily give way to *Hard Bodies*. And indeed what likelyhood is there that, that which is *Hard* and *Solid*, should be hurried along by that which is Fluid and Weak? I answer, that it must indeed be confessed, that *Fluid Bodies* are not of so great force, as those that are *Solid*, to hinder the *motions* of other *Bodies*; for seeing they having a *motion* themselves, and that *motion* is not contrary to *motion*, they do not resist them so much as *Solid Bodies*. But for all this it cannot be denied, but that the *motion of Fluids* where determin'd one way, doth carry all *Hard Bodies*, along with it. As appears in a *Stone*, which the *Water* of the *River* carries along with it, so long as it is not detained by some *External Cause*. And therefore there is good ground why the *Globe* of our *Earth*, resting in the pure *Æther*, should easily be carried about by its *Heaven*. In like manner as we see *Straws* on the surface of the *Water* carried about by the whirling round of the *Watter*, whilst some of them whirl at the same time about their own *Centers*, being all of them moved the swifter, by how much the nearer they are to the *Center* of the said *VVhirle pool*.

IX. *Fluid Bodies have the Force to carry Solid Bodies along with them.*

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X. *A Hard Body, how great soever it is, resting in a Fluid, will be moved by the least force.*

The Reason whereof is, because a *Hard Body* encompass'd with a *Fluid*, and Resting in it, lies there as in an Equal Poise; and how great soever it may be, will be easily carried away by a little force, whether that Force come from abroad, or that the *fluid Body* it self, wherein it is contain'd, be wholly carried one way; as the Course of *Rivers* tends towards the *Sea*; or as the *Air*, when the *East-Wind* blows, is carried towards the *West*; which whenever it happens, any *hard Body* that is in that *fluid*, must of necessity be carried along with it.

XI. *The Heaven hinders the Earth from Falling.*

Hence we may infer, that seeing the *Heaven* doth on all sides surround the *Earth*, and drive all the *Bodies*, that are on the surface of it, towards its *Center*, it doth by this means keep it from Falling: So that the *Earth* cannot but be carried along by it, and being thus without any *motion* of its own, yielding only to that of the *Heavens*, it may with good reason be said, to be *at Rest*. And the same may be said of the *Sun*, who is hindred by the *Globuli* of the *Second Element*, which surround him, from flying from the *Center*; and the lower *Globuli*, by those above them; and the utmost, by those of the contiguous *Vortexes* of the *fix'd Stars*, who by a contrary pressure do keep them within their Bounds.

CHAP. XI.

How the Heavens were disposed at first, and of their divers Motions.

I. *Three things are to be suppos'd here.*

IT will not be difficult to demonstrate the first *Disposition* of the *Heavens*, or that order which the *Heavenly Orbs* now observe, and did from the Beginning, by supposing only a few things, which we have proved in the *Fourth Part*.

II. *The First.*

First, That there is no *Vacuum* in *Nature*; for seeing that *Space* is not distinct from a *Body*, it must necessarily follow, that whersoever *Space* is found, there must be a *Body* also.

III. *The Second.*

That there can be no penetration of *Dimensions*; for seeing that the Conception of a *Body* involves *Extension*, and by it excludes all other *Bodies* out of the same place with it, it is evident that many *Bodies* cannot be contain'd in the same place.

IV. *The Third.*

Whatsoever is moved, is moved in a *Circle*; for seeing all places are fill'd with *Bodies*, it is clear, that one *Body* cannot be removed out of the *Neighbourhood* of some *Bodies*, into the *Neighbourhood* of others, without being mov'd in a *Circle*. So that when any *Body* enters into a *place*, the *Body* that was there before leaves it, and enters into the *place* of the next, and so on to the last; which at the same instant of time enters into the place the *first Body* hath left.

V. *What we are to understand by the words* Vortex, Center, Ecliptick, Poles *and* Axis.

It will not be amiss for us also to explain what we intend by the Words, *Vortex*, *Center*, *Ecliptick*, *Poles* and *Axis*. By the word *VORTEX* we understand, a vast number of *parts of Matter*, which move together about the same *Center*. By the *Center* of a *Vortex* we mean, the *point* about which all the *parts of Matter* that constitute the *Vortex* do move. And because when a *Vortex* turns round, all the Points of the *Surface* describe *Crooked lines*, which resemble *Circles*, except two that turn about themselves, we call those two Points the *POLES*; and the *Circle*, which is equally distant from the two *Poles*, we call the *ECLIPTICK*; and the *Right line*, which reacheth from one *Pole* to the other, passing through the *Center* of the *Vortex*, we call the *AXIS*.

VI. *How the Vortexes came first to be.*

These things premis'd, we say that the Parts of the *Universe*, being in the Beginning of the *Creation* put into *motion*, must naturally run themselves into several *Vortexes*; for these *Particles* being of different bulk and figure, and unable to move forwards in *Right lines*, because of their various determination, they were forced to move in *Circles*, and by this means did constitute *Vortexes* of a stupendous Magnitude, according to the Quantity of the *Matter*. For it is an unquestion'd Truth amongst *Philosophers*, that a *Body* which is dash'd against another, must of necessity rebound back from it, and so be carried in a *Circle*, that it may continue its *motion*, which may be proved by many Experiments. For the *Vortexes* of the *Air*, or those of the *Water*, which we see in *Rivers*, are caused, because the *Vapours* that make the *Wind*, and the running *Waters*, being beat back by occurring *Bodies*, are hindred from moving strait forwards: and therefore being reflected on one side, must necessarily turn *round*, because the subsequent *Air*, or *Water*, is successively push'd forwards after the same manner as the first, and so must twist in and be carried Circularly.

VII. *The Divisibility of Matter being suppos'd, the Vortexes could not but be made this way.*

That this was the Original of the *Vortexes* is unquestionable, by those who admit the Matter of the *World* to have been divided into *particles* of different *Magnitude* and *Figure*; and that they had as much *motion* from the beginning, as there is now found in the whole *Universe*. Because these *Particles* dashing one against another, must needs be carried round about divers *Points*, and so run together into divers *Vortexes*. So that all the *Particles* that were whirl'd about the *Sun* S, did constitute the *Vortex*, terminated by A, Y B, M, and that others which roul'd about the *fix'd Stars* L, C, O, K, compos'd other *Vortexes*.

Figure 20.

VIII. *That there are but two visible Heavens.*

We admit only two visible *Heavens*; the *first*, that whose *Center* the *Sun* S is, in which we live, and wherein *Venus*, *Mercury*, the *Earth* and the rest of the *Planets* are contained, and in which they are roul'd about with various *motions*. And the *Second Heaven* is that which contains innumerable *Vortexes* Z L Z, M C M, Y O Y, T K T, which have *fix'd Stars* in their several *Centers*, and on every side surround the *First Heaven* S. Whatsoever reacheth beyond these *Heavens*, does not fall under our Senses, tho' we conceive it Immense, and not confin'd within any Limits, being therefore called an *Expansion* or *Firmament*, from its vast and *Indefinite Extension*.

IX. *How the Vortexes came to be divided, and what the Form of them is.*

The Disposition therefore, and ordering of the several *Bodies* of this *World* was made, when the *Planets*, and all other *Bodies* that lay confounded together in the *Chaos*, were separated by the *subtil Matter* flowing between them, and got into several places, according to the thickness and solidity of the *Matter*. Whence it is evident, that the Forms of the *Vortexes*, are the very first and most simple *Forms* that were ever introduced into the *Matter*; they are the *First*, because they are the immediate product of the *Laws* of *Motion*; and *the most Simple*, because they suppose none before them; and because all other Forms depend on them, as on their *Principles*.

There

X. *How these Vortexes can perform their Motions without hindring one another.*

There is one Difficulty seems to arise from the Disposition of these *Great Bodies*, *viz.* how these *Vortexes* could fall into such a *motion*, as that one should not hinder the other: For it is hard to conceive how *Bodies* of so great a Bulk should not interfere with one another in their Circumvolution, seeing that according to the *Laws* of *Nature*, the *motion* of one *Body* is turned aside by the meeting of another.

XI. *The Difficulty answer'd.*

This Difficulty may be answer'd by shewing, that these *Vortexes* may be so placed, that their *Motions* will rather further than hinder each other; that is, if we conceive them so ranged, that the *Ecliptick* of one, (or that part of the *Vortex*, which whirling about its *Axis* describes the largest *Circle*) do correspond to the *Poles* of the other: For by this means they will so agree together, and move so freely, as not in the least to hinder one another.

XII. *The Vortexes must be so disposed, as that the Poles of one Vortex may touch the Ecliptick of another.*

Yea, if we examin the matter, we shall find that the *Heavenly Vortexes* cannot be so, but that the *Poles* of one must touch the *Ecliptick* of another. As suppose the *first Vortex*, whose *Center* is S, be moved from A, toward Y; another *Vortex* contiguous to it, whose *Center* is O, and another whose *Center* is C, must touch it in those Parts that are most remote from both the *Poles* A and B, of the *Vortex* S. For if we should suppose the *Poles* of two *Vortexes* to touch one another, they will either by a like determination of *motion* be carried the same way, and so will run one into another; or they must by a different determination be carried *oppositly* to one another, and so clashing in their *motions*, they will never be able to continue them long; and therefore to the end their *Motions* may not interfere together, the *Vortexes* must be so ranged, that the *Pole* of one *Vortex* may not touch that of another, but the *Ecliptick*, or those parts which are most remote from them; forasmuch as by this means they support and preserve one another.

XIII. *Those Parts of a Vortex which are neareſt to the Center, are most swiftly moved.*

The *First Heaven*, in which the *Sun* S is the *Center*, and by the force of whose *motion* the other *Planets* are wheel'd about, is most swiftly turn'd round by it; for the *Sun* being with great celerity whirl'd about its own *Axis* A B, carries the neareſt parts along with it, and imparts his *motion* unto them: So as that the parts neareſt to him are more swiftly moved, than those that are more remote, and so on to the Region of *Saturn* H N Q R, where the *parts* of the *Heaven* are moved slowest of all. The Reason whereof is, because those *parts* that are nearer to the *Center* of the *Vortex*, are less than those further off, and consequently are more swiftly moved. And that the *parts* towards S, are less than those that are about H N Q R, is evident; for that if they were bigger or equal, by being so near the *Center* of the *Sun*, they must needs be more swiftly moved, and by consequence possess themselves of Higher places.

XIV. *Those parts of the Vortex which are above the Region of* Saturn, *are more strongly moved.*

According to this Proportion therefore, the *motion* of the *Celestial Matter*, grows by degrees more slow to a certain term, beyond the *Region* of *Saturn* H N Q R, where the highest or utmost *parts* of this our *Vortex* begin to be more swiftly moved, not by the *Sun*, as is apparent enough; but from the Neighbouring *Vortexes*, which surround the *First Heaven*; for they being unequal, do variously shake the *Surface* of the *First Heaven*, and thereby conduce to the swiftness of those *Parts*. This great degree of their *swiftness*, appears from the swift *motion* of the *Comets*.

XV. *The Motions of the Vortexes are Circular.*

From what hath been said, we may gather these two things: *First*, That the *Vortexes* are circularly moved; for being hindred by other *Bodies*, from proceeding in a *Right motion*, they are forc'd to change the same into a *Circular*, and therefore must continually be whir'd *round*.

XVI. *It is not necessary that the Vortexes should be exactly Round.*

Yet is it not necessary that these *Vortexes* therefore should be exactly *Round*; for tho' they counterballance one another by their equal Force, yet is not this Force equally dispers'd through all their *parts*; because those which are about the *Ecliptick* of one *Vortex*, are always more strong than those that are towards the *Poles* of another: Which makes (since the *Ecliptick* of one *Vortex* commonly meets with the *Poles* of others) the *parts* that are about that *Ecliptick*, to advance more towards the *Poles* of other *Vortexes*, than the *parts* which are about the *Poles* of other *Vortexes*, do advance towards this *Ecliptick*. We see also in the precedent *Figure*, that the Neighbouring *Vortexes* make the *Vortex* S, which is between them, irregular.

XVII. *The Heavens are moved continually.*

Secondly, We may gather from what hath been said, that the Motions of the *Vortexes* are *perpetual*, since there is nothing that can be assign'd that should change or diminish their *motions*. For a *Body* therefore only ceaseth to move, because by running against another *Body*, it imparts its *motion* unto it, which cannot happen to the *Heavens*, because they have no *Bodies* at Rest, or slowly Moved, to which they may communicate their *Motion*, and so come to lose it. For the Law of *Nature* requires, that every thing, inasmuch as it is single and undivided, should remain in the same state, nor ever be changed, but from *External Causes*; and since no such *Causes* are in the *Heavens*, but all the *Vortexes* do comply together, we are rather to conclude, that they maintain and preserve one another.

XVIII. *A small Vortex may preserve it self, amongst others that are greater.*

As to the Bigness of the *Vortexes*, we have no reason to think, that all those which were the result of the First Division of the *Matter*, were all of them *Equal*. For as the only Reason we have to believe, that the vast number of *Vortexes* are not confounded one with another, is, because their Forces are equal and opposite; we may also well imagin, that a *Vortex*, which is less than those that are about it, will for all that preserve its station amongst them, if we consider that the Defect of its Bulk may easily be made up by its greater degree of Swiftness in *motion*. This Inequality of the *Vortexes* is represented to the Eye in this *Figure*, where the *Vortex* S, tho' greater, cannot destroy that of O, nor K, tho' lesser than it.

XIX. *What Bodies are said to be Heavy.*

We may gather from what hath been said, why *gross* and *Earthly Bodies*, are *Heavy* about the *Centers* of the *Vortexes*; tho' *Light*, when they are at a distance from them. For seeing these *Bodies* derive their *motion* from the *subtil Matter* wherein they swim; which Matter is actually turn'd Round, and inclin'd to move forwards in *strait Lines*; it by this means communicates its *Circular motion* to those thicker *Bodies*, which it carries along with it; but not the Force it has in proceeding in *right Lines*, save only so far as that Force accompanies the *motion* it imparts to them.

But

But becauſe the *ſubtil Matter*, which is about the *Center* of the *Vortex*, hath much more agitation than is required to *Circular motion*, (for every of the *Particles*, beſides the *Circular* or *Common motion*, are alſo variouſly moved) it ſo happens that thoſe *Bodies* which have leſs *motion*, have alſo leſs *force* to continue their *motion* by *Right lines*, and by this their weaker *force*, are forc'd to give way to thoſe, which with greater *force* preſs on towards *Strait lines*, and therefore muſt tend towards the *Center* of the *Vortex*, that is, become ſo much the more *heavy*, as they are more *ſolid*.

XX. *What Bodies are ſaid to be light.*

But when *Earthly Bodies* are at a great diſtance from the *Center* of their *Vortex*, ſeeing the *Circular motion* of the *ſubtil Matter* is very intenſe, foraſmuch as it employs almoſt all its *motion* in its *Revolution* about the *Center* of the *Vortex*, they have the more *agitation*, as they are more *ſolid*, becauſe they follow the *motion* of the *ſubtil Matter* in which they ſwim; and therefore have more *force* to continue their *motion* according to a *Right line*: ſo that the *groſſer Bodies*, at a certain diſtance from the *Center* of the *Vortex*, are by ſo much *lighter*, as they are more *ſolid*. For by the word *Lightneſs*, we underſtand nothing elſe, but the Endeavour wherewith the *Bodies* that are moved Round, tend to withdraw from the *Center* of their *motion*; as by the word *Heavineſs* we underſtand that *ſtrift*, whereby leſs agitated *Bodies*, or leſs *ſolid*, are thruſt down towards the *Center* of their *motion*, by ſuch as have more force than they to withdraw from it.

XXI. *The Planets are not Heavy.*

From hence it is evidently deducible, that the *Earth* about its *Center* is very ſolid, but leſs towards the *Circumference*; as alſo that the *Water* and *Air* muſt continue in that ſituation wherein we ſee them, and that conſequently they are *Heavy*. For ſeeing all theſe *Bodies* are more ſolid than the *Matter* of the *Firſt* or *Second Element*, they cannot avoid being puſh'd towards the *Center* by it: Whereas the *Moon*, being at a conſiderable diſtance from the *Center* of the *Vortex* of the *Earth*, is not look'd upon as Heavy, tho' it be a *ſolid Body*; as neither *Mercury*, *Venus*, *Jupiter*, and *Saturn*, which cannot fall down towards the *Sun*.

CHAP. XII.

Concerning the Action and Motion of the Heavenly Matter.

I. *How Light was made in the Firſt Day of the Creation.*

HAving thus been inform'd how the *Heavens* were ranged, and what Order they ſtill keep, we are next to conſider how the *Heavenly Matter* is moved, and what *Action* it exerts in them. For as ſoon as the *Vortexes* began to be formed, it could not be but that ſome part of the *Matter* of the *Firſt Element*, made by the rubbing of the divided *particles* againſt one another, muſt be gather'd towards the *Center*, and from thence propel the ſurrounding *Globuli*, which was ſufficient to make *Light*. And thus we may perceive how *Moſes* is to be underſtood, when he ſaith, that *GOD divided the Light from the Darkneſs*, and that *Light* was in the Firſt Day of the *Creation*: Becauſe the *Matter* of the *Firſt Element*, which was about the *Center* of each *Vortex*, preſs'd the *Globuli* of the *Second Element*, and ſo procured the *Light*. Yea, this was in ſome meaſure effected upon the firſt Turn of the *Vortex*, before the *ſubtil Matter* run to the *Center*. For by the name of *Light* we can underſtand nothing elſe, than that preſſure of the *Globuli* in *Right lines*, which does excite in us the ſenſe thereof. And therefore, when it is ſaid, that *GOD* commanded *the Light to be*, it muſt be thus underſtood, that *GOD* put the *parts* of *Matter* into *motion*, and gave them an Inclination to continue the ſame in a *ſtrait Line*.

II. *How the Sun and fix'd Stars were made the Fourth Day.*

But after that the Matter of the *Firſt Element*, by the continual rubbing together of the ſeveral *Bodies* was increaſed, it betook it ſelf in great Quantity to the *Centers* of the *Vortexes* S L C K O, and there made the *Sun* and the *fix'd Stars* on the *Fourth Day*. For ſeeing that all Circular moved *Bodies*, continually ſtrive to recede from the *Center* of their *motion*, and that thoſe that are ſtrongeſt recede farther than ſuch as are weak; it follows, that the *Particles* of the *Second Element*, that are more ſtrong than thoſe of the *Firſt*, becauſe they are ſolid, do more recede from the *Center* of their *Motion*, and that in this their receſs they puſh down thither all thoſe *Particles* of the *Firſt Element*, that are left after the filling the *Intervals*, which are between the *Particles* of the *Second Element*. Whence it follows, that about the *Center* of each *Vortex*, there is a *Body* only compoſed of the *Matter* of the *Firſt Element*, which cannot but be of a *Round Figure* that way it turns; that is to ſay, If one ſhould cut it by a Flat parallel to the *Ecliptick*, in what part ſoever this Section ſhould be made, it would be always a *Circle*: For otherwiſe it muſt be ſuppoſed, that ſome *Particles* of the *Second Element* are not ſo far removed, as they might be, from the *Center* which they deſcribe, which is impoſſible.

Figure 20.

III. *What we underſtand by the word Star.*

Now that *Body* of the *Firſt Element* which is formed in the *Center* of a *Vortex*, is commonly called a *Star*; ſo that by this word *STAR*, we underſtand nothing elſe, but a *Body* compos'd only of the *Firſt Element*, which has been driven by that of the *Second*, towards the *Center* of each *Vortex*.

IV. *The moſt ſubtil Matter is moſt ſtrongly moved within the Bodies of the Stars.*

It is evident from what hath been ſaid, that the *Matter* of the *Firſt Element*, is not every where moved alike, but more ſtrongly in the *Bodies* of the *Lucid Stars*, than without them in the *Globuli* of the *Second Element*. For the *ſubtil Matter* gather'd together in the *Sun* or *fix'd Stars*, hath a greater *force*, by reaſon of the Conſent of its Parts to all thoſe ſwift *motions*, by which it puſheth forwards the *Æthereal Matter*, or the *Heavenly Globuli*. But without the *Stars*, and between the *Globuli*, its *force* is diminiſh'd, and by being divided, is much weaker: So that every one of its *Particles* are puſh'd this way and that way, by the *Globuli*, and thereby are forc'd to comply with their various *motions*. Hence it is, that the *Matter* of the *Firſt Element*, becauſe of the exceeding ſmalneſs of its Parts, is forc'd to change its *Figure*, and to be toſs'd with various *motions*. For as it is toſt amongſt the *Globuli*, it hath ſeveral *motions*; firſt, its own *proper Motion*, by which it continually changeth the *figure* of its little *particles*, to be fit to fill up exactly all the Corners

it passeth through. Next it hath a *Circular motion*, which is common to all *motions* that are moved together. And lastly it hath a *Straight motion*, whilst by the *Circular motion* of the *Vortex*, it is thrust in great abundance towards the Parts that are most remote from the *Poles*.

V. *A motion may be various, and yet continue one and the same.*

And tho' there can be but one *Proper motion* assign'd to a thing, yet doth not this thwart the Truth of what we have just now said, because tho' this *motion* hath several names, yet it is still but one and the same, from the *Center* to the *Circumference*, by a *right Line*, tho in its going forth it may undergo several *Figures*; even as the *motion* whereby any Liquor is transmitted through a *Channel* or *Pipe* is said to be one, tho' it run to the term to which it is directed, in one place through a square *Pipe*, in another through a *Triangular*, in one through a narrower, in another through a wider *Pipe*.

VI. *The great Globuli, are more strongly moved than the less.*

We are also to take notice of some difference there is between the *Globuli* of the second *Element*, because the Bigger, as being *more Solid*, are more suited to receive a swift *motion* from the matter of the first *Element*, than the Less, and therefore they are more swiftly moved, and withdraw further from their *Center*.

VII. *The matter of the first Element continually passeth from one Vortex to another.*

Next, we are to consider that the first *Element*, is continually carried towards the *Center* of each *Vortex*, from other Neighbouring *Vortexes* about it, by those Parts which are neareſt to the *Poles*, where there is least resistance, that so they may make up again that which is lost: But that the same matter breaks out of its own *Vortex* into others, by the *Ecliptick* or those parts which are furthest from the *Poles*. For let us suppose A B, to be the *Poles*, about which the *Vortex* in which we are, *Whirls* round, H and Q to be the *Ecliptick*, or Parts most remote from the *Poles*, where the *motion* is the *Swiftest*. Let us also suppose the *Vortex* to be A Y B M, round about which four others *Vortexes* L C K O rowle, so as to touch O and C, at their *Poles*, and the other two K and L, in those Parts that are most remote from their *Poles*; I say, this supposed we may easily guess, that the matter which strives to withdraw from the *Axis* A B, of our *Vortex*, doth with greater Force tend towards the Parts Y and M, than towards A and B. The reason is, because the most subtil matter in Y and M, meets with the the *Poles* of the *Vortexes* O and C, where there is no great Force of Resistance; whereas in A and B, it meets with those parts of the *Vortexes* K and L, which are most remote from their *Poles*, and have a greater Force of moving from L and K, towards S, than the Parts about the *Poles* of the *Vortex* S, have to tend towards L and K; and therefore it is manifest, that the most subtil matter which is in K and L, must move on towards the *Center* of our *Vortex* S, and that that which is in S, must tend towards the opposit *Vortexes* C and O. So that as much of this subtil matter, as gets out through Y and M, so much of the same matter enters, from the other *Vortexes* L and K through the *Poles* of our *Vortex*.

VIII. *But not the Matter of the second Element.*

But there is no such passage of the matter of the second *Element* from one *Vortex* to another; for being whirld round as well as the subtil matter, it endeavours to preserve its Swiftness, but would certainly lose much of the same, if it should wander out of the limits of its own *Vortex*, since the motion is so very slow in the *Polar Parts* of the other *Vortexes* M and Y, that it cannot meet with any free entrance there. Yea, tho' we should suppose, that the *Æthereal Globuli* should pass from the *Poles* of one *Vortex*, towards the *Center* of another; and that all the matter both of the first and second *Element*, contained in the *Vortex* L, at the very same moment of time, had begun to move, from the middle place between the *Centers* S and L, towards S; yet we shall easily understand, that the said subtil matter will arrive sooner at the *Center* S, than the *Globuli* of the second *Element*. Because the Agitation of the first *Element* far surpasseth that of the second, and hath always an open passage, through those little *Angles*, which cannot be fill'd up by the matter of the second *Element*. To which we may add, that the matter of the first *Element*, by passing through the narrow spaces left by the *Globuli*, meets with no impediment, nor loseth any part of its Swiftness, seeing that according to the Laws of *motion*, it always endeavours to recede from the *Center*, and hath a force to persevere in its Swiftness.

IX. *How the matter of the first Element is moved amongst the Stars.*

Having thus seen how the *Matter* of the *first Element*, which is impatient of *Rest*, breaks forth from one *Vortex* to another; we are to enquire how the said *matter* is moved amongst the *Stars*. Consider we therefore, that a part of the most subtil *matter*, in the Space *d e f g*, where we place the *Sun*, moves from A, by a *right line* to *d*, and there meeting with the *Globuli* of the second *Element*, beats them back towards B; and that contrarily another part of the said *matter* comes from B to *f*, and there drives before it the *Globuli* of the second *Element* which it meets with, towards A, and that immediately thereupon, as well the *matter* about *d*, as about *f* becomes reflected towards all the parts of the *Ecliptick e g*, and doth equally drive before it all the adjoyning *Globuli* of the second *Element*, and lastly gets away into M Y, through the materials that separate those *Globuli*, about the *Ecliptick e g*.

X. *The motion of the matter of the first Element is the cause of the Roundness of the Stars.*

Whereupon this Space must needs be *Spherical*, because the *matter* of the first *Element*, which is entred into the *Body of the Sun* by its *Poles* A B, must equally beat back all the circumjacent *Globuli* of the second *Element*, as well *those*, against which it is only obliquely reflected, as the other against which it pusheth in a direct *Line*; after the same manner as we see, that a *Glass pipe* is formed Round, because the *Air* driven through the *Iron pipe*, with an equal force spreads it self round, and equally presseth it on all sides.

XI. *The motion of the subtil matter amongst the Globuli is various.*

The matter of the first *Element* without the *Stars*, or whilst it wanders between the *Globuli* of the second *Element*, hath a various *motion*. For first it hath a *Proper motion*, whereby it runs to the filling up of the little Spaces left by the *Globuli* of the second *Element*, which the diversity of *motion* changeth every moment. And it hath also a *Circular motion* about the *Poles*, common to the whole *Heaven* A M B Y; because that which is contained between the little spaces of the *Globuli*, follows the *motion* of them. As *Water* contained in a *Barrel*, follows the *motion* of it, and accommodates its self to its *Figure*. It hath also a *Straigh motion*, from the *Poles* A B to the *Sun*; and likewise from the *Sun* to the *Ecliptick* Y M, according-

ing to the Law of *motion*, that *things which are circularly moved, always tend to recede in a right Line, from the Center of the Circle they describe.*

XII. *The matter of the first Element hath a greater force in the Stars than without them.*

VVhence it appears that the matter of the first *Element*, collected in the *Center* of the *Sun* and *fixt Stars* hath a very great Force, because the *motion* of all its *particles* do readily agree and conspire together, to push forward the *Globuli* with an equal Force: But this Force grows weaker out of the *Body* of the *Stars*, because it spends the greatest part of its Agitation, in changing the *Figures* of its little *Particles*, to the end it may exactly fill all the little Corners through which it passeth.

XIII. *Of the Figure of the Strait or Screw-like Particles.*

VVherefore whilst the matter of the first *Element*, passeth through the *Triangular* intervals 1 and 2 of the *Globuli* touching one another, it must needs assume a *Triangular Figure*, and become shaped into striate *Particles* 3 and 4 bent a contrary way. It is not easy to determin the length of those *Particles*, because this depends on the slenderness or abundance of the matter, whereof they are made: But it is sufficient to conceive them like little *Columns*, with three Notches round them *like a Screw*; so that in their whirling round, they may pass through those narrow passages 1 and 2 of a *Triangular Form*. For seeing that they are longish, and with a most swift *motion* pass between the *Globuli* of the second *Element*, which touch one another, whilst the *Globuli* in the mean time by a different *motion* are whirld round, about the *Poles* of the *Heavens*, we clearly understand, that their *Notches* must go winding about, like those of *Screws*, which winding must be more or less according as they pass through parts that are more remote from the *Axis* of the *Vortex*, or nearer to it, because they move more swiftly in those, than in these.

Figure 21.

XIV. *The Globuli of the second Element, have not the same bigness every where.*

As to the *Globuli* of the second *Element*, of which the *Vortexes* consist, they are not all of the same bigness; for those that are nearer to the *Star* and its *Center*, are less than those that are farther off, and consequently absolve their *Circle* in a less time. VVhich inequality of their Magnitude, extends it self to the Region of *Saturn* H N Q R, where the parts of *Heaven* move most slowly. Yet beyond that *Orb* it is probable, that the *Globuli* are all of an equal Magnitude, and that the Higher move more swiftly than the Lower. So as that the Higher must move more swiftly towards M and Y, than the Lower towards H and Q. The reason whereof is amongst other things, that the bordering *Vortices* being unequal, the *motion* of the subtil matter, between those unevennesses of the surface, becomes much accelerated.

Figure 20.

CHAP. XIII.

Of the Heavenly Sphere and its Circles.

I. *What the Sphere is.*

BY the word *Sphere* we understand that common instrument of a round *Figure*, consisting of several *Circles*, invented to explain and represent the *Heavenly motions*, and the Fabrick of the whole *VVorld*. This *Sphere* hath a little *Ball* in the midst or *Center* of it, with an *Axis* through it, the Extremities whereof are called *Poles*, about which the whole *Body* of the *Heavens* is supposed to turn round in the Space of 24 hours.

II. *What an Axis is.*

The *Axis* of the *World* is a *right Line*, which extending from one *Pole* to the other, passeth through the *Center* of the *World*. By this the *Earth* is said to be supported: Not that there is indeed any such visible *Axis* in the *Globe* of the *Earth*, which is terminated in the *Heavens*, and whereby the *Earth* is sustained; but only that such a *Line* is understood, which passing through the *Center* of the *Heaven* and *Earth*, reacheth to the utmost *Heaven*, and ends at two points, which are called the *Poles* of the *World*.

III. *What the Poles are.*

The *Poles* therefore are nothing else but the Extremities of the *Axis*, or two *Points* in the highest *Heaven*, *Diametrically* opposit, about which the whole bulk of the *Heavens* is conceived to be whirld about. The one of these *Poles* is always visible to us, and from its nearness to the constellation of the *Bear* is called *Artick*, the other which is always hid from us, being from its opposition to the former called *Antarctick*.

The Northern Pole is reard in sight on High,
The other hid under our Feet doth lie.

IV. *The Circles of the Sphere are either greater or less.*

There are ten *Circles* in an *Artificial Sphere*, six whereof are called *Greater*, whose *Diameter* passeth through the *Center* of the *World*, or which divide the *Sphere* into two equal Parts, and these are the *Horizon* and *Meridian* (between which standing immoveable, the other *Circles* are turnd round) the *Æquator*, the *Colure of the Solstices*, the *Colure of the Æquinoxes*, the *Zodiack* or broad *Circle*, and the middle line thereof, which is called the *Ecliptick*. The four lesser *Circles* are those whose *Diameter* doth not pass through the *Center* of the *World*, or which divide the *Sphere* into two unequal *Parts*. They are the *Tropick of Cancer*, the *Tropick of Capricorn*, the *Arctick* and *Antarctick Circle*, which also with the *Æquator* are called *Parallels*, as being at an equal distance from each other.

V. *The Equinoctial Circle.*

The *Æquator* or *Æquinoctial Circle*, which is the chiefest of all the rest, is that *Circle*, which in all its parts is equally distant from the *Poles* of the *World*, which it divides into the *Northern* and *Southern Hemisphere*. By the Greeks it is called the *Even-day Circle*, because the *Sun* twice in a year, that is about the 10 of *March*, and the 13 of *September* intersecting the same, makes two *Æquinoxes*, by rendring the *Days* and *Nights* equal, through his equal stay above and under the *Horizon*, because the *Æquotor* intersected by the *Horizon*, becomes divided into two equal parts, one Superior, and the other Inferior.

VI. *The Zodiack.*

The *Zodiack* is a greater *Circle* superinduced over the other moveable *Circles*, unequally distant from the *Poles*, and intersecting the *Æquinoctial* at two opposit *Points*; so that its middle line which is called the *Ecliptick*, hath one part of it inclining to the *North* Twenty three degrees, and Twenty eight minutes, according to the Antients, and the other part of it as many degrees reaching towards the *South*. This *Circle* is conceived Broad, because the *Planets* which move through it, do not all of them keep the same tract, but whilst the *Sun* takes it Course through the midst of this they *Circle*, along the *Ecliptick* they swerve to the *North* and *South*. The *Points* at which the *Zodiack* Intersects the *Æquator*, are called the *Æquinoctial Points*: because when the

Sun

Sun reacheth them, it makes *Day* and *Night* of equal length. And the *Points* by which the *Ecliptick*, declines furtheſt from the *Æquinoctial*, are called the *Solſtitial Points*, becauſe when the *Sun* comes to them he ſeems to ſtand ſtill. The *Zodiack* is furniſht with twelve *Signs* or *Conſtellations* of which hereafter.

VII. *The Colures of the Solſtices and Equinoxes.* The *Colures* are two greater *Circles*, which interſecting one another in right *Angles* at the *Poles*, do interſect all the other moveable *Circles*, dividing them into four equal *Parts*. For the *Colure of the Solſtices* paſſeth through the *Poles* and the *Solſtitial Points* of *Cancer* and *Capricorn*; but the *Colure of the Æquinoxes* is deſcribed through the *Poles* of the *World*, and the *Æquinoctial Points* of the *Zodiack*, at *Aries* and *Libra*. The uſe of the *Colure* is to mark out the four *Cardinal Points*, *viz.* the beginning of *Aries*, where whilſt the *Sun* is, the *Night* is equal with the *Day*, and the *Spring* begins; the beginning of *Cancer*, where the *Sun* makes the longeſt *Day*, and begins *Summer*; the beginning of *Libra*, where the *Sun* makes *Day* and *Night* equal, and begins *Autumn*; and the beginning of *Capricorn*, where the *Sun* makes the ſhorteſt day, and *Winter* begins.

By Crab and Capricorn Solſtice is made,
The Ram and Ballance equal Light with Shade.

VIII. *The Horizon.* The *Horizon* is the *utmoſt Circle* in a *Sphere*, encompaſſing all the reſt, and is that *Circle* which is equidiſtant from the *Vertical Point* of every place; and therefore is called by the Greek *Horizon*, that is to ſay, *Terminator* or *Finiſher*, becauſe it boundeth our ſight. For when ſtanding in a *Plain* we take a Proſpect round about, we ſee the *Heavens* every where, as it were touching the *Earth*; from which Commiſſure of the *Heaven* and *Earth* as the *Stars* get upwards, they are ſaid to *Riſe*, and when they ſink beneath it are ſaid to go down. Tho' the *Horizon* with regard to every particular place of the *Earth* be *immoveable*, yet conſidered in general it is mutable, foraſmuch as whilſt we Travel from one place to another, we alſo paſs from one *Horizon* to another.

IX. *The Meridian.* The *Meridian* is a greater *Circle* which paſſeth through the *Poles*, and the two *Points*, the one directly over our heads, called the *Vertical Point*, and the other oppoſit to it, under our Feet called the *Nadir*. This immoveable *Circle*, within which the other *Circles* are moved, is called the *Meridian*, becauſe when ever the *Sun* reacheth it, he makes *Noon* or *Midday*, by dividing the *Day* into two equal Parts. Whence it appears, that the *Altitude* or *Elevation* of the *Pole* in every *Country*, is nothing elſe but that *Arc* of the *Meridian*, which is intercepted betwixt the *Horizon* and the elevated *Pole*, and whoſe complement to the *Zenith* or *Quadrant* of the *Circle*, is always equal to the *Altitude* of the *Æquator*.

X. *The Tropicks of Cancer and Capricorn.* The *Tropick of Cancer* is a leſs *Circle*, Parallel to the *Equator*, paſſing through the *Northen Solſtitial Point* of the *Zodiack*. The *Tropick of Capricorn*, is a leſs *Circle*, *Parallel* to the *Æquator*, paſſing through the *Southern Solſtitial Point* of the *Zodiack*. They are called *Tropicks*, that is to ſay *Turn-agains*, for that as ſoon as the *Sun* in his withdrawing from the *Æquator* reacheth them, he begins to return again towards it. Their diſtance from the *Æquator* is 23 Degrees and an half; that being the furtheſt Elongation the *Sun* ever makes from that Line; wherefore, alſo it is called the greateſt *Declination* of the *Sun*.

XI. *The Artick and Antarctick Circles.* The *Artick* or *Northern Polar Circle*, is a leſs *Circle*, *Parallel* to the *Æquator*, paſſing through the *Pole* of the *Zodiack*, near the *Northern Pole*. The *Antarctick* or *Southern* is a *Circle* paſſing through the other *Pole* of the *Zodiack*, near to the *Southern Pole*. Theſe two *Circles* are at the ſame diſtance from the *Poles*, as the *Tropicks* from the *Æquator*, that is 23 Degrees and an half. They have alſo this common uſe with the *Tropicks*, that they ſerve to diſtinguiſh the *Zones*, the *Torrid* being comprehended within the *Tropicks*; and the *Frigid* within the *Polar Circles*; but the *Temperate Zones* lie between the *Polar Circles* and the *Tropicks*.

XII. *Whence the Latiude of a Place is taken.* All theſe *Circles*, the *Æquator*, *Ecliptick*, *Meridian*, with the *Tropicks* and *Polar Circles*, are applied to the *Terreſtrial Globe*: For the *Earth* alſo hath its *Equator*, commonly called the *Line*, correſponding to the *Cæleſtial Æquator*; and every place on the *Earth* hath its own *Meridian*. And theſe *Circles* are exceeding uſeful to diſtinguiſh the various Situation of *Places*, as well as to the Art of *Navigation*, and to the Knowledge of *Geography*. For ſince we may diſtinguiſh the *Earth* as well as the *Heaven*, in Length and Breadth; the *Latitude* of any *Place* is nothing elſe, but a Portion of the *Meridian*, intercepted between the *Æquator* and that *Place*. Wherefore, thoſe who live under the *Æquinoctial* have no *Latitude*; whereas they have the greateſt *Latitude*, who are at the greateſt diſtance from the *Æquator* under the *Poles*. The *Latitude* of a *Place*, is the ſame with the *Elevation of the Pole*, for they who live under the *Line*, ſee both the *Poles* in their *Horizon*, but as we withdraw from the *Æquator*, one of the *Poles* is Elevated above our *Horizon*, and the other depreſt beneath it.

XIII *Whence the Longitude is taken.* But the *Longitude* of a *Place* is taken in the *Æquator*, and is nothing elſe but a Part of the *Æquinoctial Circle* intercepted between the *Meridian* of any particular place (ſuppoſe *Paris*) and the firſt *Meridian* appointed by the conſent of Men, which *Meridian* is conceived to paſs through the *Iſlands*, of *Azores*.

XIV. *What a Right Sphere is.* A *Sphere* is either Right or Oblique. A *Right Sphere* is that whoſe *Horizon* paſſing through the *Poles* of the *World*, cuts the *Æquinoctial* at Right or Equal *Angles*.

XV. *What an Oblique Sphere.* An *Oblique Sphere*, is that whoſe *Horizon* cuts the *Æquator* at unequal *Angles*, and doth not paſs through the *Poles* of the *World*.

They therefore have a *Right Sphere*, who live under the *Æquator*, and they an *Oblique* who live under the *Tropicks*. Whence it appears that the *Sun* and the reſt of the *Stars* in a *Right Sphere* A B C D, to them that live under the *Æquator* B, Figure 22. ſeem to riſe and ſet in *Right Lines*, both the *Poles* lying on the *Horizon*; whereas in an *Oblique Sphere* E F G H, (where one of the *Poles* E, and Figure 23. the *Axis* of the *World*, is more or leſs obliquely inclin'd towards either ſide of the *Horizon*) they are ſeen to riſe above the *Horizon*, come to the *Meridian*, and ſet beneath the *Horizon* obliquely. For any one may eaſily apprehend, that where both the *Poles* lie on the *Horizon*, there the *Æquator* muſt be *Vertical*; and ſeeing it cuts the Hori-

zon

To the Right Honourable S.r Henry Goodrick of Ribston Park in York-Shire K.t and Baronet, Leivtenant Generall of their Majesties Ordenance, and one of the Lords of their most Honourable Privy Councell &c.a

Fortior Leone Justus

This Plate is humbly Dedicated by Richard Blome.

zon at *Right Angles*, the *Stars* must needs arise and set in *Right Lines*; and in like manner, whatsoever else is in the *Heaven*, forasmuch as all the *Circles*, which they describe *parallel* to the *Æquator*, will likewise cut the *Æquator* at *Right Angles*. And on the contrary, those that live between the *Æquator* and the *Elevated Pole*, because of the Oblique ascent and descent, have some *Stars* always in sight, and others ever out of sight.

CHAP. XIV.

Of the SUN.

I. *How the Sun was formed at first.*

FRom what hath been already said of the *Action* of the *Heavenly Matter*, we may easily understand how the *Sun* was formed at first. For whilst the *Globuli* of the *Second Element*, being more *solid* than the *Matter* of the *First*, withdrew from the *Center*, betaking themselves to the *Circumference*, the most *subtil Matter* being increased to too great a quantity (from the continual rubbing of *Bodies* against one another) to be contained in their Intervals, rush towards the *middle part*, where being tost with different *motions*, and most swiftly whirl'd about its *Center*, it constituted the *Sun*, and the other *fix'd Stars*. For seeing that our *World*, in the midst whereof the *Sun*'s Seat is, and which extends it self beyond the *Sphere* of *Saturn*, doth constitute one great *Vortex*, whose fluid and transparent *Matter* is circularly moved; it must follow that the *Globuli* of the *Second Element* will strive to recede from their common *Center*, and as far as their *Figure* and *Motion* will permit, come nearer together, and lye upon one another; which they cannot do, without driving the *Matter* of the *First Element*, whereof there is greater store than is needful, to fill their Intervals, towards that place which they have left; so that it cannot be, but that about the *Middle* of the *Vortex*, there must be a great *concourse* of the *Matter* of the *First Element*; which we take to constitute the *Body* of the *Sun*.

II. *What the Sun is.*

Accordingly we may define the *Sun* to be *a Lucid Body, consisting of the Matter of the First Element, gather'd together in the Center of a Vortex, in the room of the Globuli that recede from it.*

III. *Why the Sun is Round.*

From the Account we have here given of the *Sun*'s *Formation*, we gather *first*, that the *Sun* must be of a *Round Figure*; because the most *subtil Matter* entring the *Sun* at either of its *Poles*, continues its course in a *Right line*, until it meet with the *Globuli* of the *Second Element*, which are about the opposite *Pole*, and running against them, drives them forward by the force of its *motion*, and thereupon is *immediately* reflected, and turns round in all its parts towards the *Ecliptick*, and so drives forwards the adjacent parts of the *Second Element*, that are next to the *Center* of the *Star*, and by this means makes the *Sun* to be *Round*: So that if it should be intersected by a *Plain*, parallel to the *Ecliptick*, in whatsoever part the Section be made it will always be a *Circle*. For otherwise it would follow, that some parts of the *Second Element*, do not recede so far as they can from the *Center* of the *Circle* they describe; but this is impossible, considering the *Fluidity* of the *Heavens*.

IV. *Why the Sun is Lucid.*

In the *Second place*, we infer from hence that the *Sun* is *Lucid*; because the Matter of the *First Element*, gather'd together in the *Center* of the *Vortex*, by pressing every way upon the *Heavenly Globuli*, (besides the *motion* they have, as they are a *Liquid Body*) do communicate to them such a force or impression as is sufficient so to affect our *Eyes*, as to produce the *sense* of *Seeing*.

V. *How it comes to pass, that the Sun appears so much greater to us than any of the fix'd Stars.*

The *Sun* therefore, and the rest of the *fix'd Stars*, shine with their own *Light*, which their brisk and lively *Rays* are an evident Proof of. And the reason why the *Sun* appears *so great* to us, in comparison of the *fix'd Stars*, is, because he is nearer to us, who are in the same *Vortex*. For which reason also, the *Sun* doth not only abundantly illuminate our *Earth*, whence he is called in *Scripture, the Greater Light*; but also communicates *heat* and *warmth* to the same: Whereas the *fix'd Stars*, tho' visible to us; because of their Remoteness can do neither.

VI. *The Sun is a Fluid Body.*

The *Sun* therefore is no *solid Body*, neither a *burning Stone*, nor *Red-hot Plate*, as some of the *Ancients* apprehended, but consisting of a very fluid and movable *Matter*, which whirls all the Circumjacent parts of *Heaven* round with it. And thus much is not only confirm'd to us by *Reason*, but also by *Astronomical Observations*: For SIMON MARIUS, in *Scheinerus* his *Rosa Ursina*, tells us, That he had beheld the *Sun* thro' an *Optick Glass*, *boyling like molten Gold in a Furnace*. ATHANASIUS KIRCHERUS, in his *Book* entituled, *Ars magna Lucis & Umbræ*, writes, That he had seen the *Sun*, *like to the Sea, tost and foaming with Waves*. And RAPHAEL AVERSA assures us, That he had observ'd the *Sun* to be *a Fluid Body, contain'd in its place, as if it were in a Vessel, and agitated within it self, like a molten Metal*. Yea, there are several who have assured me, that the whole *Body* of the *Sun* boyls continually, and that they had often observ'd it through a *Prospective-Glass*, *boyling* like *Water* in a *Kettle*.

VII. *The Sun is a true Fire.*

Whence all *Modern Philosophers* that are of any Note, take it for granted, that the *Sun* is nothing else but a *Fire* or *Flame*. Since we have great reason to conclude that *Body*, which gives forth *Warmth* and *Light*, to be *Fire*; but we Experience the *Sun* to give forth *Heat* and *Light*: Therefore we must conclude the *Sun* to be a *Fire*. The *Minor* is manifest, because we are convinced that both these proceed from the *Sun* by our *Feeling* and *Sight*; neither do we find any thing in the *Fire*, which we may not with equal right attribute to the *Sun*. *Besides*, we cannot conceive any *Body* to have an *inborn* or *connatural Light*, by means of which it produceth *Heat*, except it be of the nature of *Fire*. Wherefore, seeing the *Sun* is as communicative of *Light* and *Warmth*, as *Fire* is, and that both of them have the same Properties; for the *Sun dries, melts, kindles*, and *burns*, as well as *Fire*: Therefore we must conclude that the *Sun* is *Fire*. For we can have no stronger *Argument* to prove two things to be the same, than by demonstrating, that all the *Effects* of one of them, do also proceed from the other. For as if any one by *Night* should meet with a *Body* that sent forth *flames*, heated the *Bodies* that were near it, and enlightned the *Air*, he would make no scruple to conclude it to be a *Fiery Body*: In like manner,

seeing the *Sun* performs all these things, we are not to question but that it is a *Fire* or *Flame*.

VIII. *Why the Sun's heat is greater in Summer than in Winter.*

But against this you will object, *First*, if the *Sun* were a *Flame*, and as such continually diffus'd its *heat* through the whole *World*; it would follow from hence, that the *Air* would never be *cold*; but this is contrary to Experience: For we find the *Air* much hotter in *Summer*, than in *Winter*.

Some endeavour to solve this Objection, by saying, that the Difference of *Heat* we feel at divers *Seasons*, proceeds from the various incidence of the *Sun-beams* on the *Surface* of the *Earth*, which in *Summer* come down to the *Earth* more directly, and in *Winter* more obliquely or slantingly. But this Answer will scarcely satisfie those, who consider that the *Surface* of the *Earth* is not polish'd, as a *Looking-Glass*, but rough and very uneven; and that consequently it may receive direct *Rays* in *Winter*, as well as *Summer*. The reason therefore why the *Cold* is more intense about the *Earth* in the *Winter-season*, is, because the *Air* we breath in, which is ten or twelve Miles high, hath a very smooth and even *Surface*, as having no *Winds* to ruffle it; and the *Sun-Rays* falling very slantingly in the *Winter* upon this smooth *Surface*, is the reason why fewer *Rays* are transmitted to us in *Winter*, than in other *Seasons* of the *Year*. To which may be added, that more *Vapours* and *Exhalations* at that time proceed from the *Earth* and *Sea*, which filling the *Air*, do allay the *Heat* of the *Sun*.

IX. *The Sun is fed and maintain'd as our Fires are.*

In the *Second place*, you'l object, That our *Fire* here below stands in need of *Fewel*, which is no sooner taken away, but it becomes extinct, and vanisheth: But in the *Heaven* there is no *Fewel* to feed the *Sun*'s *Flame*: Therfore it is a great mistake to suppose it a *Fire*.

X. *The Sun's Flame is not weakned by the Bodies that are about it.*

I Answer in the *first* place, That the state of the *Sun*, and our *Flames* here below, is very different: For our *Flames* stand in need of Nourishment, because they are compos'd of a *Fluid* and *Moveable Matter*, which is easily destroy'd by the *Bodies* that surround it; and therefore it is needful it should be furnish'd with *New Matter*, to supply that which is extinguish'd and vanisheth. But above the *Sun* there are no such *Agents* as are able to dissipate its *Matter*, and therefore it needs no *Fewel* to preserve it. For so vast a quantity of *Fiery Matter* is heap'd up in the *Sun*, that it can neither be exhausted or extinguish'd by it self, nor by the *Heaven* that surrounds it.

XI. *The Sun is fed and maintain'd by the Matter of the First Element.*

I answer in the *Second* place, That the *Matter* of the *First Element* is the *Fewel* of the *Sun*'s *Flame*, which is continually convey'd to the *Sun*, in the room of the like *Matter*, it loseth at any time. For the *Stars* entertain such a *Communication* among themselves, as to convey *food* to one another through their *Vortexes*, bestowing upon others what goes out by their *Ecliptick*, and receiving from others what comes in by their *Poles*. And thus *New Matter* continually enters into the *Sun*, by the *Poles*, and other *Matter* again flows out from it, in that part which is fartheſt from the *Poles*. And accordingly the *Sun* is always said to be the same, in like manner as a *River* is supposed the same, notwithstanding that *New Matter* continually makes up the defect of that which runs away.

XII. *How the Sun makes Twilight.*

The *Sun* is not only the Cause of the *Light*, which in the *day time* is diffused through the *Air*; but also of the *Twilight*, which is perceived in the *East* before its *Rising*, and in the *West* after its *Setting*; forasmuch as the *Rays* of the *Sun* falling obliquely upon the *Vapours* that are in the *Air*, are *refracted* towards the *Earth*. The Beginning of this *Twilight* happens, when the *Sun* is depresst beneath our *Horizon*, about 18 *Degrees*, perpendicularly taken from the *Vertical Circle*. Hence it is, that in those parts of the *Earth* where the *Sun* doth not in *Summer* sink below the *Horizon* 18 *Degrees*, there they have a continual *Twilight* all *Night* long.

XIII. *There are no certain Points of the Sun's Rising and Setting.*

Whatsoever part of the *Earth* the *Sun* salutes with his *Rays*, there he is said to *Rise*; and to *Set* in those *Parts* which he ceaseth to illuminate. Now forasmuch as there is no part of the *Earth* in which he may not sometimes *Rise*, and sometimes *Set* in this manner, we may assert, contrary to the Vulgar receiv'd Opinion, that there are no certain *Points* of the *Sun*'s *Rising* or *Setting*.

CHAP. XV.

Of Light.

I. *The Opinion of the Peripateticks, concerning Light, refuted.*

THe *Peripateticks* generally are of Opinion, that *Light* is a Quality really distinct from *Substance*; and propagated to the *Senses* they don't know how. But this *Opinion*, at present, hath but few Followers:

First, Because it is evident, that *Qualities* are no *Entities* really distinct from *Substances*, but only their *Modifications*, which neither can remove from the *Substances* wherein they are, nor do any thing without them.

Secondly, Because the *Beams* of *Light* are *reflected* from some *Bodies*: Now every *Reflexion* is caus'd by *Resistance*, and whatsoever meets with Resistance, must be *Corporeal*; but forasmuch as *meer Qualities*, abstracted from *Substances*, include nothing of *Corporeity*, neither can they be liable to *Resistance*. Whence we must conclude, that *Light* which is *Reflected*, is no *pure Quality*, separately existing from the *Lucid Body*.

Thirdly, The *Rays* of *Light* are *refracted*, and by the help of *Convex-Glasses* are strengthned; which could not be in case the *Light* were a meer *Quality*, for then, as being destitute of all *Quantity*, it would equally penetrate all *Bodies*. For the better understanding whereof, two things especially are to be supposed.

II. *Two things are to be supposed, in order to the understanding of the Nature of* Light.

First, That all *Bodies* consider'd in themselves, strive to move in *Right lines*. For a *Stone* thrown from you always moves strait forwards towards some part or other; nor ever turns aside, except by other *Bodies* meeting with it, it be forced to rebound or deflect. *Secondly*, That whatsoever is *Circularly* moved, as far as it is able, strives to recede from the *Center* of its *motion*; as we may experience in a *Leaden Bullet* tied to a *String*, for wee feel that the swifter the *Bullet* is whirl'd about, the stiffer the *String* is extended and stretch'd; which cannot be attributed to any other Force, but because it strives to recede from the *Center* of its *motion*.

When

III. *What is to be understood by the word* Striving.

When I say, that the *Bullet* strives to withdraw from the *Center* of its *motion*, it is not so to be understood, as if the *Bullet* or any other *Body* had a perceptive inclination to move one way rather than another; but only that it hath such an impulse to *motion*, that it would move in such a manner, in case it were not hindred of something else.

IV. *How Light is produced.*

We assert therefore, that *Light* consists only in this, that the *Matter*, which is in the *Center* of every *Vortex*, by its swift *whirling* about, doth shake the *Luminous Matter*, that is dispers'd throughout the whole *Heaven*, and all *Diaphanous Bodies*, which in *Right lines* beating against the *Nervous Fibres* of the *Tunica Retina*, produceth that perception, whence *Bodies* are denominated *Lucid*: For as a *Blind man* by the means of his *Staff*, because of its Resistance only, is able to distinguish betwixt *Bodies*; tho' no *Species* be transmitted by the *Stick* to the *Eye*: So likewise the Cause of the Perception of *Light* is nothing else, but that a certain *Matter* dashing against the *Organs* of *Sight*, stirs up the *Soul* to such an Animadversion.

V. *What Light, and the Rays of Light are.*

Light therefore is a *Quality proceeding from the Vibration of the Globuli diffus'd in Right lines, and moving the small fibres of the Optick Nerve, disperst through the Net-like Membran of the Eye.* Which is then chiefly, when the *Matter* of the *First Element*, contained in the *Center* of the *Sun*, or any other *Lucid Body*, strives to withdraw from it: For in so doing it presseth the adjacent *Globuli* of the *Second Element*, and they again those which are above them to the very last. So as that by this means the *Light* is diffused in a moment, to any distance whatsoever. Which will not be hard for us to conceive, if we consider that the *Action* of *Light* doth not so much consist in *Motion*, as in *Pression*, or a first disposition to *Motion*; and therefore that the *Rays* of *Light* are nothing else but so many *Lines*, by which that *quick* and *lively Action* is performed.

VI. *The Sun equally diffuseth its Light.*

From whence we conclude, that the *Sun* doth not more forceably drive forwards the *Matter* which is towards the *Ecliptick*, than that which is towards its *Poles*: For the *Sun* being of a *Round figure*, the *Matter* of the *First Element* entring into its *Center*, doth equally drive from it all the *Globuli* that surround it; so that no greater Force proceeds from one, than from any other *Point* of its *Superficies*, by which means infinite *Rays* are extended to every part of the *Body* it illumi nates.

VII. *What is required to the Production of Light.*

To the Production therefore of *Light*, is required, *First*, *Matter* very swiftly agitated, as is that which is in the *Center* of every *Vortex*. *Secondly*, A certain *Matter* that is shaken, as is that *Matter* which is about the *Stars*, that is, the *Globuli*. *Thirdly*, It is requisite that this *Matter* be shaken or vibrated in *Right lines*, or such as are equipollent to Right ones: For tho' in all *Diaphanous Bodies*, the *Pores* are not *Mathematically strait*; yet are they sufficiently so, for the transmission of the *Action of Light*. *Fourthly*, That this *Vibration* of the *Matter* be such, that by Moving the *Nerves* the *Soul* may be excited to that perception we call *Sense*; for it is our *Soul*, and *not the Body that is sensible*. When therefore either the *Organ* is unfit to receive this *Vibration*, or that it be affected by any stronger *Vibration*, the *Sensation* will be thereby hindred. And this is the reason, why after the *Sun* is *risen* we cannot see the *Stars*; because the stronger *Vibration* of the *Sun*, renders the weaker *Vibration* of the *Stars* imperceptible, except it be in case of some very great *Eclipse*.

VIII. *The farther the Beams of Light withdraw from the Luminous Body, the less and weaker they grow.*

Tho' the *Light* diffuse it self on every side, and equally drive before it the adjacent *Matter*; yet is its Action lessen'd according to the *Degrees* of its elongation from the *Luminous Body*. The better to comprehend this, suppose we the *Tube* A B C here decypher'd, enlarging it self by *degrees* to contain *Water* as high as D E; and let afterwards, by means of a *Spring*, so much *new Water* be spouted into it by the *Hole* A, as may be sufficient to fill the *Space* A F G, which tho' it be of some height, yet it hath but little breadth; it will hence appear, that by the accession of this *New Water*, the *Water* contained in the *Tube* will be sensibly raised a little higher towards H I, but not toward D E. By which *Example*, the Nature of *Light* is fitly illustrated: For as we cannot say, that the *Water* above D E is not raised higher at all, but only that it is raised very little; so in like manner we must say, that the farther the *Beams* of *Light* recede from the *Luminous Body*, the weaker and less their *motion* is. Figure 24.

IX. *How tho Light must be reflected upon its meeting with some Bodies.*

As a *Body* that is in *motion* upon meeting with another *Body* that resists it, doth lose its determination, and is forced to turn aside; as we experience in a *Ball*, which being struck against a *Wall*, rebounds; so we are to conceive, that the *Light* meeting with some *hard Body*, is by it reverberated. For seeing that *Light* is nothing else but a *pression* of the *Globuli* of the *Second Element*, which tho' in the *Pores* of *Water*, *Air*, *Glass*, and other such like *Bodies*, do touch one another in various *ranks* or *rows*: Suppose the *Globuli* that constitute the Row C D, to represent those Parts of the *Second Element* that constitute one *Ray*, falling upon the *hard Body* A B; it is necessary that the *Action* of this *Ray*, be continued by the *Line* D E, towards E, that so the *Angle* of *Reflexion* B D E, may be equal to the *Angle* of *Incidence* A D C; that is, this *Action* must be transmitted by the very same *Lines*, which the *Globulus* C would describe, in case it were alone, and were moved by the *Line* C D: For it is manifest, that the *Globulus* D is *disposed* to move onwards that way it would really move, if its Power were reduced to act. And because this *Globulus*, by meeting with the *Body* A B, would neither tend towards G nor H, but only towards F, it is evident that the *Globulus* F only is push'd forwards by it, and that that alone receives its *Action*. This is confirm'd by daily Experience, for we find that the *Sun-beams* falling upon the Surface of any *Compact Body* (as *Gold*, or *Steel*) are reverberated, and that the *Lights* Angle of *Reflexion*, is equal to the *Angle* of Incidence. Figure 25.

X. *Light cannot be Fire.*

I know no Body that hath better explained the nature of *Light* than our *Author*: And tho' they who maintain *Light* to be *Fire*, do support their Opinion by strong *Arguments*, yet they struggle with many difficulties, which are of no force against our *Opinion*. For according to their *Hypothesis* two *Bodies* would be in one place, if *Light* and *Fire* were one and the same thing. Again there

are

are many things that give *Light* without imparting *Heat*. Moreover, what shall we say becomes of the *Light*, when the *Sun* leaves our *Hemisphere*? shall we suppose that such a vast *Body* can perish in a moment? And lastly, how can the *Light* without interruption or disturbance reach our *Eyes*, when the *Air* is shaken by *Winds*, seeing one *Body* always resists another? And other such like difficulties that may be urged against the *Light*'s being *Fire*.

IX. *No inconveniences follow upon supposing Light to be Motion.* But by constituting the nature of *Light*, in the *Pression* of the *Subtil matter*, we are delivered from the Danger of *Penetration* of *Dimensions*: neither are we necessitated to admit that *Light*, is always in conjunction with *Heat*; forasmuch as the *matter* of the *first Element*, can withdraw from the *Center* of the *Lucid Body*, and push forwards the *Globuli* of the *second*, which compass it about without producing the effect of *Heat*, as appears in *Glow-worms* and *Rotten-wood*. Neither are we pinched by that Question which demands, what becomes of the *Light* when the *Sun* withdraws from our *Hemisphere*, seeing we maintain the *Light* to be no more than *motion*, which cannot but cease as soon as the cause vanisheth. Neither needs the objection of the *Air* tost with *Winds* to trouble us, forasmuch as the Intervals, which we conceive to be between the *Parts* of *Bodies*, are fill'd with the *Subtil matter*, and are always open for the *Globuli* of the *second Element*, so that nothing hinders the *Light* from coming to us in a *Right Line*.

XII. *How Light is transferred in a Moment.* There is one *difficulty* only which seems somewhat to affect us, *viz.* how the *Light* of the *Sun*, and *fixt Stars* can reach our *Eyes* in a moment; yet even this also will be removed, if we consider, that the nature of *Light* doth not consist in the *Duration* of *Motion*, but that it is only a *Subitaneous Action*, directed to our *Eyes*, through the *Pores* of the *Air* and other *Diaphanous Bodies*; much after the same manner, as we by night with a *Stick* can discern and distinguish between *Water*, *Clay*, *Stones* and such like: For we then experience that the same *Action*, wherewith the end of the *Stick* toucheth the *Body*, is at the same instant felt at the Head of the *Stick*: And which would be the same were the *Stick* never so long, as might be demonstrated by many Examples.

XIII. *An objection Answered.* If it be objected, that the *matter* of the second *Element* being *Fluid*, a Range of its little *Pellets* reaching from the *Sun* to our *Eyes*, cannot have the same effect in pushing fowards in a *right Line* as a *Stick* would and must have; for the more round and slippery these *Pellets* are, the more apt they are to slide away, and by this means to make the impulsion of no effect. To this I answer, that tho' the *matter* of the second *Element* be the most *Fluid* of all *matters*, yet this doth not hinder but that a Rank of them, reaching from the *Sun* to our *Eyes*, may be as effectual in pushing, as an *inflexible* stiff *Line*: For the *World* being every where full, every Ray of *Light*, hath always many others about it, which hinder it from sliding away, and consequently transmits the Action of the *Lucid Body*, in the self same manner as if it were a stiff *Stick*.

XIV. *In the Transmission of Light there is no Translation of a Body.* You'l say, that no *Motion* can be made in an instant. We grant it, for in that *Motion* wherein the Action of *Light* consists, no *Body* is transmitted, but the *Motion* only is transferred from one *Body* to another. For the *Sun*, who is the *Principle* and *Fountain* of *Light* is not transmitted to our *Eyes*, but its *motion* only is continued to our *Eyes*, by means of the *Subtil matter*, which fills the *Pores* of the *Air*, and other *Pellucid Bodies*. Nor is it any contradiction that a *motion* should be transmitted in an instant, tho' no *motion* can be made in an instant.

XV. *How the solar Light might appear though there were no Sun.* From what hath been said, it may be clearly understood, how that *Action*, wherein we conceive the nature of *Light* to consist, spreads and diffuseth it self every where from the *Body* of the *Sun* and *fixt Stars*, and how in the least moment of time it extends it self to the farthest distance; and to *Right Lines*, not only from the *Center of the Lucid Body*, but as well from any other *Points* of its *Surface*: Whence all other Properties of *Light* may be deduced. And I may add further, which will seem to some a great *Paradox*, that all these things would happen in the *Heavenly matter*, tho' there were no force at all in the *Sun* or any other *Star*, about which it was whirld: So that if the *Body* of the *Sun*, were nothing else but an empty *Space*, yet should we perceive his *Light* as well as now we do, (tho' it would not be so strong) at least in that *Circle* wherein the *Heavenly matter* is moved.

XVI. *How Des Cartes is to be understood, when he saith that Light is only a Propension to motion.* Some, it may be, will object that *Des Cartes* makes *Light* to be nothing else, but an *Aptitude* to *motion*; as when he saith *Dioptric.* Cap. 1. *that Light is nothing else, but the Action of the Cœlestial matter, or a Propension to motion.* Now if it be only a *Propension* to *motion*, it is no *motion*, and therefore the *Light*, which he saith, is received in the most *Subtil matter*, that fills the *Pores* of other *Bodies*, will never be produc'd, as long as it hath only a Propension to push forwards the same. Whence we must conclude, that if *Light* be an *Action*, and that such an one, as tends to the production of *motion*, *Light* must be before *motion*; for every *cause* is before its *effect*, and therefore *Light* cannot be *motion*.

XVII. *The distinction of Lux and Lumen, or Light in its Fountain, and Light in the Medium.* This difficulty will be easily cleared, by distinguishing betwixt *Light* in its *Fountain* or *Principle*, such as are *Lucid Bodies*; and *Light* in a *Medium*, that is, any *Transparent Bodies*. The Propension to *motion*, or pression which is in the *Lucid Body*, as the *Fountain*, is properly called *Lux*: But when considered in its progress, that is, in the *Heaven*, or the *matter* of the second *Element*, then it is called *Lumen*, tho' *Authors* commonly confound both these *words*, using them promiscuously; *Lux* therefore, or *Light* in its *Fountain*, is a Propension to *motion*; or is that *Action* in *Lucid Bodies*, which tends to produce some *motion* in *Transparent Bodies*, which is *Lumen* or *Light* in a *Medium*. Neither doth it imply any absurdity to say, that *Light* in the *Fountain*, preceeds *Light* in the *Medium*, since every cause is before its *effect*. The *motion* therefore which is in *Lucid Bodies*, produceth another *motion*, that is, *Light* in the *Air*, and other *Pellucid Bodies*.

XVIII. *The Sun is not before the Light.* It may be you'l urge, that if *Light* be that *Action* or *Motion*, whereby the *Sun* or any other *Lucid Body* pusheth forwards the *Subtil matter*, which is in *Transparent Bodies*, then the *Sun* must be conceived to be *before* that *Action*, and by consequent would be destitute of all *Light*; every *cause* being before its *effect*.

But

X. *The Answer* But I answer, that this doth not follow, because the *Light* it self, or that *motion*, whereby the *Sun* doth circularly push fowards the *Subtil matter* whereof it is composed, is natural to it, and therefore it is not necessary, that as an *Efficient cause* it should be before it. Forasmuch therefore as the *Sun* is composed of the most *Fluid matter*, which is wholly whirld about its *Center*, it is necessary according to the *Rules of motion*, that it press the *matter* of which the *Heaven* is made, that is, the *Subtil matter*, which from the *Stars*, reacheth to our *Eyes*; in which *Action*, the nature of *Light* consists.

CHAP. XVI.

How Spots come to be Generated about the Sun, and fixt Stars, and how they vanish again.

I. *What the Spots of the Sun are and who was the first discoverer of them.* BY the *Spots* of the *Sun*, we understand those close or compact *Bodies*, consisting of gross and slow *Particles*, mixt with others that are more Thin and Subtil, which since they cannot comply with the *motion* of a more *Subtil matter*, are cast out from it; and by reason of their slower *motion*, clinging together about the *Surface* of the *Sun*, continue there for some time, and follow the *Suns motion*, according to the course of the *Ecliptick*, till by the *Suns* force they be dissolved, or suckt in again by it, or wholly expell'd from it. The first Observer and Discoverer of these *Spots* was *GALILÆUS*, in the year 1610, when he was *Mathematick Professor* in the University of *Padua*; and asserted them to be contiguous to the *Body* of the *Sun*, and that they moved round it, or rather were whirld about by the *Solar Globe* in the Space of 26 or 27 Days.

II. *The Colour and Figure of the Solar Spots.* The *Spots* of the *Sun* appear for the most part of a *Black-colour*, and are commonly surrounded with a *Darkish cloud*, which in the inside is more *Bright* than it appears on the outside. They vary their *Figures*; as appears by that *Spot* which was first discovered by the Famous *CASSINUS* in 1672, and which appeared 36 or 37 Days. These *Spots* are moved more slowly from the *Eastern part* of the *Sun*, to the *West*, and pass from one brim to the other in about 13 Days time. Their *motion* is found to be more swift near the *Center*; and they seem to make as great way in that part in 4 Days, as they do in 9 or 10 Days when they are near the *Circumference*. They appear likewise bigger in the *Center*, but near the *Circumference* long and narrow. From this their swifter *motion* near the *Center*, it is concluded either that they cling to the *Sun*, or at least are very near to him.

III. *How these Spots are formed.* Now as to the manner of their *Formation* we are to note, that the *Particles* of the first *Element* are not all of them of the same *Bigness* and *Figure*; and tho' we conceive them to be very *Little*, yet withal we must conclude some of them to be cornerd, and not so fit for *motion*, if we consider the Spaces or Intervals of the *Globuli* through which they pass: For these Spaces being mostly *Triangular*, they by passing through them get the same *Figure*, not much unlike the form of a *Screw*, as hath been before observed: By which means it is, that they cannot move so swiftly as before, but do as it were rest or lye still, with respect to others that are more swiftly moved, and so more easily cling together. For tho' they retain the name of the first *Element*, as long as they continue between the *Globuli* of the second *Element*, because then being yet in their swift course, they only fill up the Spaces that are betwixt the *Globuli*, without composing any grosser *Bodies*: Yet they obtain the name of the third *Element*, when they come near to the *Body* of the *Sun*, especially the more gross and slowly moved *Particles*; for seeing they cannot comply with the *motion* of the rest of the subtil Matter of the first *Element*, they are cast out from it, and by running together into great Lumps or masses, they obscure and at last wholly hide the *Star*, from whence they came forth; for by clinging to its *Surface*, they darken and obstruct the *Light* proceeding from it, and hinder it from pushing forwards the subtil Matter in right *Lines*, wherein the force of *Light* doth consist.

IV. *Spots are of two sorts* Some *Spots* are more *Solid*, and very compact, as are those which run round the *Sun*; others are *more thin*, and therefore dissipable, such as are those which sometimes appear about the *Sun*, and then vanish again.

V. *Spots like a kind of Scum, stick to the Star whence they proceed.* For as we see that *Water* or *Oil boyling* in a *pot*, doth cast off those *Particles* that are less fit for *motion*, and raise them up to the *Surface*, reducing them into *Scum*: So the *Sun*, whose *matter* is agitated with a fervent *Heat*, doth cast off from it, those grosser and many corner'd *Particles*, which cannot accommodate themselves to the motions of others, and these afterwards running together, constitute a kind of Scum, and so obstruct the *Light*. Which then more especially happens, when the *Sun* darts his *Rays* more forceably against them, for by this means, they are driven more closely together, and become more compact.

VI. *The Sun appears sometimes more dim and obscure because of the interposition of his Spots.* By this means it may happen, that a *Spot* which at first is *Soft* and very thin, may at last grow to that hardness, as to stop the passage of the *Suns Rays*. Thus *Historians* assure us, that the *Sun* hath been seen for many days together of a *Pale colour*, not much exceeding the weak and dim *Light* of the *Moon*. Neither, in my Judgment, is there any other reason assignable, why some *Stars* appear now greater, and at other times less, but because their Aspect is varied, according to the diversity of *Spots* that surround them: Yea, they may sometimes become so totally cover'd by them, that for many years they may be hid from us. So formerly the *Constellation* of the *Pleiades* consisted of 7 *Stars*, whereas now 6 only can be seen.

VII. *How a new Star may suddenly appear.* And on the contrary it sometimes happens, that a *Star* not seen before, all on a sudden appears to the *World*: Which is when the *Vortex* wherein the *Spot* is, by pressing the Neighbouring *Vortexes* more strongly, than they press it, doth enlarge its Bounds; by which means the *Matter* of the first *Element*, rushing in more abundantly, to the obscured *Star*, diffuseth it self over the *Surface* of the *Spot*; as *Water* is seen sometimes to over-flow the *Ice*: and then the *Star Shines* forth as *Bright* as if it had no *Spot* at all to darken it. According to this *Hypothesis*, we may understand how the *New Star* came to appear in *Cassiopeia* in the year 1572, which continued for 2 years, but

appeared greatest at first, and afterwards being darkned by Degrees, at last wholly vanished.

VIII. *How these Spots are sometimes turned into Torches.* It also happens sometimes, that the *Solar Matter* flowing about the *Spots* wherewith it is coverd, doth rise above or beyond them, which *Matter* being thus pent up between them, and the *Surface* of the Neighbouring *Heaven*, is made to move more swiftly; as a *River* that is straitned in its passage doth run with more violence. And for this reason it is, that often *Torches* or *bright Flames* have been seen where formerly *Spots* appeared; and so on the contrary, the parts of *Spots* beginning to appear again, *Spots* have been seen where formerly *Torches* appeared.

IX. *Why the Spots about the Sun move so slowly.* The *Spots* about the *Sun*, take up no less time than 26 Days in running round it, notwithstanding they are so near to the *Body* of it; which *slowness* of their *motion* proceeds chiefly from hence, that a kind of *Æther* is generated, of the *Striate Matter* which the *Sun* continually casts forth, which extending it self a great way towards the *Orb* of *Mercury*, doth hinder the *motion* of the *Maculæ*.

X. *The Cause of the Darkness which happened at the Death of Christ.* It doth not appear by *Authors*, whether the whole *Earth* was darkned at the Death of *Christ*, or the *Holy Land* only: But supposing (as it is most probable) that the whole *Earth* was obscured (as the *Scripture* seems to assert, and *Dionysius* the *Areopagite* does plainly witness, who was a Spectator of this wonderful *Eclipse* at *Heliopolis* in *Egypt*) the cause of this Obscuration can't be attributed to any thing better than to these *Spots*. Seeing it is possible for one *Spot* to spread it self over the whole *Surface* of the *Sun*, and to continue there for some time, before it be dispers'd again. And forasmuch as the *Body* of the *Moon* is much less than that of the *Sun*, we must conclude, that this total *Obscuration* could not proceed from the *Moon* alone, without the assistance of these *Solar Maculæ*, or *Spots*.

XI. *The Moon assisted in the obscuration of the Sun, at our Saviour's Death.* I will not deny, but this famous *Eclipse* might be caused by the intervention of the *Moons* Body, notwithstanding that it hapned at the time of the *Full Moon*. It appeared so to St. *DENYS*, as he testifies in his *Epistle* to *Polycarpus*: *Whilst I was* (saith he) *at* Heliopolis *in* Egypt, *I beyond all expectation saw the Moon upon the Body of the Sun.* Whereupon, as being astonished at this *Prodigy*, he cried out, *Either the God of Nature suffers, or the Frame of this World is dissolving.* But then, because the *Body* of the *Moon* was not great enough to effect a total obscuration, the *Solar Spots* came to its assistance, and wholly cover'd the *Sun* for three Hours together.

XII. *How these Spots come to disappear again.* As these *Spots* are generated, so in like manner are they dissolved again and vanish. For as *Oil* and other *Liquors*, do after some time suck into themselves again the Scum that hath cover'd their *Surface*; so likewise the *Striate Particles*, that cover the *face* of the *Sun*, in process of time grow less; and as they at first came from it, so they return to the *Sun* again. Except the thickness of the Parts, into which they are resolv'd, be such, that they are not able to pass through the *Globuli*, that are near the *Sun*; and therefore are forc'd to wander about, and disperse themselves in the adjacent *Heaven*.

CHAP. XVII.

Concerning COMETS.

I. *The Nature of Comets.* COMETS are certain *Bodies* appearing amongst the *Stars*, in the utmost part of our *Heaven*, and that in various *Forms*, and in bigness resembling *Mars*, *Jupiter*, or *Saturn*, when they are cover'd with a *Mist* or little *Cloud*. They are compos'd of the Parts of the *Third Element*, and are so solid, that after they have for some time been swiftly carried in our *Heaven*, they are cast off into some of the Neighbouring *Vortexes* of the *Second Heaven*, and so disappear to us. They are sometimes called *Hairy Stars*, because of *Beams* like *Hair* proceeding from them, by which they are distinguish'd from the *Planets*, which appear exactly Round.

II. *How Comets agree with, and differ from Planets.* The *Comets* therefore agree with the *Planets*, in that both *Planets* and *Comets* are Vast, Round, Opake *Bodies*, flowing or swimming in the *Heaven*. And they differ, in that *Planets* are less solid than *Comets*, and therefore not capable of so great agitation, as whereby they may be driven out of the *Sun's Vortex*, into other Neighbouring *Vortexes*; as *Comets* which have a stronger impulse, by reason of their greater solidity, do continually pass out of one *Vortex* into another.

III. *The Peripaticks suppose Comets to consist of Earthly Exhalations.* The *Peripaticks* rank *Comets* amongst *Fiery Meteors*, and therefore attribute their *Generation* to *Exhalations* arising from the *Earth*, and kindled in the upper *Region* of the *Air*; but the *Modern Philosophers* are of a different Opinion, and that for these following Reasons.

IV. *Reasons against the foresaid Opinion.* *First*, Because *Comets* are in the *Heaven*, and not in the *Air*, as being observ'd to have either no *Parallax* at all, or a very small one, that is, less than the *Moon*, and consequently must be at a greater distance from us than she is: *For the lesser the Parallax of any Star is, the greater is the Distance.*

Secondly, *Comets* cannot consist of *Earthly Exhalations*, because they are bigger than the *Earth* it self: For their appearing *Diameter* (their Distance consider'd) is oftentimes greater than the *Diameter* of any of the *Planets*. *The appearing Diameter is different, according to the Distance of the Body, as being Smaller in a less Distance, and Greater in a greater Distance.*

Thirdly, If *Comets* were kindled *Exhalations*, no reason could be given why they should not decrease daily, as their *fewel* decreaseth; whereas we find that they all increase and decrease after one and the same manner: For they are less at the Beginning and End of their appearing, and biggest in the Midst. But because some relate, that *Sublunary Comets* have at some times appeared, we will distinguish *Comets* into *Bastard* and *True*.

V. *The distinction of Bastard and true Comets.* We call those *Bastard Comets*, which are compos'd of *Earthly Exhalations*, raised into the upper *Region* of the *Air*, and there kindled. But *True Comets* are such as are above the *Moon*, and which shine by reflecting of the *Sun's* Beams, not by being kindled into a *Flame*. Those of the first kind, if any such be, are *Meteors*; but the latter are all *wandring Stars*.

VI. *What a Comet is.* A *Comet* therefore *is a Wandring Star, compos'd of the Matter of the Third Element, which because of its solidity and great agitation passeth from*

I. The Nature of Comets.

II. How Comets agree with, and differ from Planets.

III. The Peripaticks suppose Comets to consist of Earthly Exhalations.

IV. Reasons against the forsaid Opinion.

V. The distinction of Baseard and true Comets.

VI. What a Comet is.

G. Freman. Inv. I. Kip Sc.

To the Worship-full Andrew Lant
of Thorp-vnderwood in the County of
Northampton Esqr.
This Plate is humbly Dedicated by Richard Blome

from one Vortex to another. I take both *Comets* and *Planets* to be perpetual *Bodies*, made in the Beginning of the *World*, and continually toſt between the Superiour or utmoſt parts of the *Vortexes*.

VII. *The Original of Comets.* But to the end we may the better underſtand the Original of *Comets* (in caſe we ſhould ſuppoſe any of them to be produc'd anew) we are to remember, that the *Matter* of the *Firſt Element*, which from other adjacent *Vortexes*, paſſeth thro' the *Poles* into the *Center* of our *Vortex*, doth carry along with it many *ſtriate Particles*, which being unfit to comply with the ſwift agitation of the *ſubtil Matter*, are caſt forth; which afterwards, becauſe of the *inequality* of their *Figures* eaſily cling and ſtick faſt together, and by this means come to conſtitute great *Maſſes*, and being cloſe to the *Star* from whence they proceed, reſiſt the *Action*, wherein the Nature of *Light* conſiſts; and in this reſpect, are very like thoſe *Spots* about the *Sun*, which we have already ſpoken of.

VIII. *How a fix'd Star becomes changed into a Comet.* Now, whenever it happens that a *Star* is cover'd with ſo many and thick *Spots*, as that its *Vortex* becomes ſwallow'd up of other adjacent *Vortexes*: Then if it be ſo ſolid, that before it comes to that Term or Limit, where the parts of the *Vortex* are moſt ſlowly moved, it happens to acquire a *motion* equal to that of thoſe Parts amongſt which it is, in this caſe it deſcends no lower, but from this *Vortex* paſſeth into others, and becomes a *Comet*. But if it be leſs ſolid, and conſequently deſcends beneath that Bound, then it continues there at a certain diſtance from the *Star*, which is in the *Center* of that *Vortex*, and whirls round about it, and by this means becomes a *Planet*. For this is the difference betwixt a *Comet* and a *Planet*, that a *Comet* being more ſolid, is carried from one *Vortex* into another; whereas a *Planet* continues fix'd to one *Vortex*, and is obſequious to its *motion*.

IX. *The Air is not the Place of Comets.* Tho' Modern *Authors* be much of the ſame mind with one another about the *Subſtance* of *Comets*; yet are they at great Variance about the *Place* of them. *Some* will have them generated in the *Third Region* of the *Air*, as being of Opinion, that the *Exhalations*, of which they ſuppoſe *Comets* are made, cannot aſcend higher. But this Opinion, as hath already been made out, is not probable; foraſmuch as the ſame *Comet*, is at the ſame time perceived in divers very remote Parts of the *World*, eſpecially that of the Year 1618, which was ſeen in *Europe*, and in the *Eaſt-Indies*, which could not have been, had its place been in the *Air*.

X. *They run round the Earth in 24 Hours.* Beſides, *Comets* commonly compaſs the whole *Earth* in 24 Hours time, and are obſerv'd to make the ſame ſtay above, as under the *Horizon*. All which may eaſily convince us, that they muſt be above the *Air*. For the *Earth* is not far diſtant from the *Circle* of the *Air*, and compar'd with it, hath a conſiderable Magnitude; ſo that if from its *Surface* we ſhould divide the *Air* into two Halves, they would not be equal, but the Half hid from our ſight, would far exceed the other; and accordingly a *Comet* would longer continue under, than above the *Horizon*; which we find not to be ſo.

XI. *The Place of the Comets is between Saturn and the fix'd Stars.* *Comets* therefore are to be placed in that *Space*, which is between *Saturn* and the *fix'd Stars*; as appears by their Excurſions, and other of their *Appearances*. Neither can they be placed amongſt the *Planets*, foraſmuch as they are Regular in their *Motion* about the *Sun*, and never wander out of their *Spheres*. And by this means we may eaſily apprehend, how *Comets* abſolve their Revolution in 24 Hours time, and continue no longer under, than above our *Horizon*; becauſe the Bigneſs of the *Earth* being inconſiderable, with reſpect to that *Space* they move in, we may well enough divide the *Circle* of the *Air* into two equal Halves.

XII. *Why ſome Aſtronomers ſay, that Comets are only above the Moon.* And tho' *Tycho*, and other *Aſtronomers*, who have acurately obſerv'd their Appearances, have only ſaid, that they were above the *Moon*, towards the *Spheres* of *Venus* or *Mercury*, and not above *Saturn*, (tho' they might as well have concluded, that from their *Calculations*;) the Reaſon whereof was, becauſe they diſputed againſt the *Ancients*, who took the *Comets* to be *Meteors*, and therefore were content to ſhew that they were in the *Heavens*, and were loath to attribute to them all the height, which they had found out by their Calculations, leſt they ſhould be disbelieved, by advancing ſuch incredible *Paradoxes*.

XIII. *Comets that wander out of our Heaven, are no longer ſeen by us.* But foraſmuch as the Space which is between *Saturn* and the *fix'd Stars*, is *Immenſe*; we ſay that *Comets*, how great ſoever they may be, cannot be ſeen by us, if they be far diſtant from our *Heaven*; for the *Light* which they borrow from the *Sun* is very weak, neither have they force enough, at ſuch a diſtance, to affect our *Sight*. Which is the Reaſon, that when they approach to the *fix'd Stars*, they diſappear; or if their *Body* appear, yet their *Tail* is hid. But the *fix'd Stars*, which are beyond them, eaſily tranſmit their *Light* to us, becauſe they have a *Light* of their own, which makes them dart their *Rays* more ſtrongly; whereas *Comets* that ſhine only with a borrowed *Light*, muſt be in our *Heaven*, to be ſeen by us.

XIV. *How the Comets are moved.* The *Comets* do all of them ſeem to move about the *Earth* from Eaſt to Weſt, and in this their *Motion* they deſcribe *Circles* almoſt *parallel* to the *Æquator*. But beſides this apparent *Motion*, which is common with them to all the reſt of the *Stars*, they have another that is *peculiar* and *proper* to themſelves, but very irregular and indeterminate, by which ſome of them move from Eaſt to Weſt, others from Weſt to Eaſt, or to other *Coaſts* of the *Heavens*. Neither can their Courſe be ſaid to be Regular, but rather various and unequal, ſince ſome of them paſs through a greater Space of *Heaven* than others. But however Great this Space may be, there are but few of them that ever were perceived to run through above one Half of the *Heaven*.

XV. *What the Beard, Tail, and Hair of Comets is.* When a *Comet* caſts its *Rays* towards that part of the *Heaven*, whither it is carried by its own *Motion*, ſuch *Rays* are commonly called a *Beard*; but when they tend to that part from whence it tends, then are they called the *Comets Tail*; and when they are caſt forth circularly, we call them *Hair*, or a *Roſe*.

XVI. *The Cauſe of theſe Appearances.* It will not be difficult to give a Reaſon of theſe *Phænomena*, if we call to mind that the *Heavenly Globuli* of the *Vortex* wherein we live, are by ſo much leſs, as they draw nearer to the *Center*; and by degrees grow greater and greater until the

Sphere

Sphere of *Saturn*, where they are of an equal bigneſs, and are more ſwiftly moved. When therefore a *Comet*, taking its Courſe beyond the *Region* of *Saturn*, tranſmits the *Rays* it receives from the *Sun* to us, it at the ſame time puſhes forwards the *Globuli* of the *Second Element* in *Right lines* to our Eyes, which imparting their active Force to others that are under them, produce an entire and pure *Light*, which makes the *Head* or *Body* of the *Comet* to appear to us: Whereas thoſe which fall obliquely upon the little *Globuli* that are beneath, or on the ſides of them, are partly refracted, and ſo repreſent a *Beard* or *Tail* to us. But thoſe which are diſperſt round about on all ſides, exhibit *Hair*, or a *Roſe*. For the variety of all theſe Appearances proceeds only from the *Reflexion* of the *Rays* of *Light* upon the *Comet*; which having been refracted by paſſing through the *Heavenly Globuli*, are ſo received into our *Eyes*, as if they came from thoſe parts, where we think we perceive the *Beard*, *Hair*, or *Tail* of the *Comet*.

Figure 26.

Thus the *Globuli* of the *Second Element*, 3, 2, 1, 9, 7, which are extended from the *Sun* to the utmoſt Bound of the *Sphere* of *Saturn* H, C, I, are very ſmall, whereas thoſe that go beyond that *Sphere* H, F, A, 4, 5, 6, I, do exceed them in Bigneſs; ſo that each of the greater *Globuli*, that are in the utmoſt part of the *Sphere* of *Saturn*, may be ſurrounded by 7 or 8 of the ſmaller *Globuli* that are lower. And foraſmuch as the greater *Globuli*, falling perpendicularly upon the *Sphere* of *Saturn*, do puſh upon few of thoſe that are under them, they muſt neceſſarily produce only a weak *Refraction* of *Light*; whereas on the contrary, thoſe that fall obliquely upon it, ſince they have many little ones on one ſide of them, muſt needs make a greater *Refraction* of weak *Rays*. As for Example; the Greater *Globulus* C, falling perpendicularly on the little ones that are under it, hath only 2 *Globuli*, *viz.* 1 and 3 on each ſide, and therefore both ways produceth ſmall *Refractions*, deflecting from the Perpendicular C B, whereof the one is only directed from C to D, but the other from C to E: But the greater *Globuli* H and I, falling obliquely on the leſſer, do puſh forwards 6 or 7 of them, *viz.* thoſe that lye under them; and therefore the greater *Globulus* I, produceth a conſiderable *Refraction* from I unto B, deflecting from the Perpendicular I K; and ſo likewiſe the great *Globulus* H, makes a great *Refraction* from H, to B, deflecting from the Perpendicular H G.

XVII. *How Comets come to appear with Tails, Hair, and like Beams.*

Hence it appears how *Comets* come to appear with *Tails*, *Hair*, or like *Beams*. For let us ſuppoſe the *Sun* to be S, and the *Sphere* through which the *Earth* is ſuppoſed to be carried in 24 Hours time, to be 2, 3, 4, 5; the Term from whence the *Heavenly Globuli* begin to grow leſs and leſs by degrees till they reach the *Sun*, to be D, E, F, G, H, and C, to be the *Comet* plac'd in our *Heaven*; it is manifeſt that the *Rays* of the *Sun* are not only *reflected* from the *Comet* in the *Right lines* C F 3, C H 6, C G 4, C E 2, and C D 7; but that they are alſo *refracted* ſide-ways, and diſperſed; ſo that according to the various Poſition 2, 3, 4, 5, of the Spectator upon the *Globe* of the *Earth*, the *Comet* ſeems either to have a *Tail*, as in 2 and 4; for

Figure 27.

by means of the direct *Rays* C, G 4, or C, E, 2, the *Body* or the *Head* of the *Comet* appears to us, and by the help of the *refracted* and weaker *Rays*, its *Tail* or *Hair* is diſcovered by us: Or with *Hair*, as in 3; for its *Head* is ſeen by us, by means of the ſtrong and direct *Rays* C, F, 3; and by the *Refracted* and weaker on one ſide of it, C, G, 3, and on the other C, E, 3, we ſee the *Hair* of the *Comet*: Or nothing but its *Tail* is ſeen by us in the form of a *fiery Beam*, as in that part of the *Sphere* of the *Earth* 5, by means only of the weaker and *refracted Rays* C, D, 2, 5, or C, H, 4, 5; becauſe no other *Rays* can reach the Eye of the Beholder, as long as he is poſited in that part of the *Terreſtrial Orb*, marked 5.

XVIII. *A Reaſon given of the various Appearances of Comets.*

And from what hath been laid down, a Reaſon may be alſo given of all the other *Phænomena* of *Comets*. As,

Firſt, Why they appear rarely, and not at ſet *times* or *ſeaſons*.

Secondly, Why they do not move long in our *ſight*.

Thirdly, Why they ſeem to be leſs at the Beginning, greateſt in the Midſt of their Courſe, and afterwards grow leſs and leſs by degrees. Which happens, becauſe at firſt they are further from us; in the middle of their Courſe, nearer, and in a fitter condition to reflect their *Rays*; and towards the end of their Courſe, again more remote from us.

Fourthly, Why their *Motion* at the beginning is *ſlower*, in the middle *ſwifter*, and at the end *ſloweſt* of all. The Cauſe whereof is, becauſe the *Comet* at its firſt ingreſs meets with ſome Reſiſtance, becauſe of the Renitency of the *Vortex*, from whoſe Force it afterwards receives power to move more *ſwiftly*; and towards the end of its Courſe it is reſiſted by the Neighbouring *Heaven*, towards which it tends.

XX. *Why no Hair appears about* Saturn.

If any demand, why no *Hair* appears about *Jupiter* and *Saturn*, as well as about the *Comets*? I anſwer, That ſometime there is a kind of appearance of *ſhort Hair* ſeen about them, in that part which is oppoſite to the *Sun*, in places where the *Air* is very pure and clear. Wherefore, when *ARISTOTLE* ſaith, *Lib.* 10. *Meteorologic. cap.* 6. that *the fix'd Stars have ſometimes been ſeen, with Rays in the manner of Hair about them*, I ſuppoſe it ought rather to be underſtood concerning theſe *Planets*. But as to that which he relates of the *Hair*, that appeared about one of the *Stars* in the Thigh of the *Great Dog*, it muſt have proceeded either from ſome very oblique *Refraction* in the *Air*, or rather from ſome fault or defect in his *Eyes*: For he adds, That it was leſs conſpicuous when he fix'd his *Eyes* ſtrongly upon it, than when he beheld it more remiſly, and without any earneſt intention.

CHAP. XVIII.

Of the Nature, Original, and Affections of Planets.

I. *What the Planets are.*

THe *Planets are Various, Round, and Opake Bodies, hanging in the Vortex of the Sun, and by it carried about the Sun, as a kind of a common Center of their Motions, receiving its Light, and variouſly conveying the ſame to our Eyes.*

Eyes. That they are ſolid and opake *Bodies* *GALILÆUS* ſhews, who by the help of his *Tube* hath diſcover'd no leſs inequalities in the *Moon*, than we meet with in our *Earth.*

II. *Their Number.* There be *Seven* of them, which are counted in this order; *Saturn*, *Jupiter*, *Mars*, the *Earth*, the *Moon*, *Venus* and *Mercury.*

III. *Whether the Sun be to be reckon'd amongſt the Planets.* The *SUN* is commonly counted to be one of the *Planets*, but by a miſtake; for beſides that the *Sun* is not an *Opake*, but a *Lucid Body*, nor hanging in another *Vortex*, but having its own proper *Vortex*; neither hath it likewiſe a *wandering Motion*, like the *Planets*, but is continually turn'd round in its own *Vortex*; and therefore cannot be reckon'd amongſt the *Planets.*

IV. *The Planets are compounded of the Matter of the Third Element.* The *Planets* were formed of the *Particles* of the *Third Element*, from the running together whereof they became great *Bodies.* For no ſooner was *Motion* communicated to the ſeveral Parts of the *World*, but the *moſt ſubtil Parts* (made ſo by their rubbing againſt one another) conſtituted the *Sun* and *fix'd Stars*; the *Round parts* (which Roundneſs they obtain'd alſo by their running againſt each other) made the *Heavens*; and the *thicker* and *groſſer Parts*, being by reaſon of the inequality of their *Figure*, leſs fit for *motion*, formed the Seven Planets; ♄ *Saturn*, ♃ *Jupiter*, ♂ *Mars*, ☿ *the Earth*, ☽ *the Moon*, ♀ *Venus*, and ☿ *Mercury.* So that the whole Matter of this viſible *World* may aptly be divided into three General Heads of *Bodies*, *viz.* ſuch as *ſend forth Light*, as the *Sun* and *fix'd Stars*; ſuch as *tranſmit Light*, as the *Heavens*; and ſuch as *Reflect the Light*, as the *Earth*, with the reſt of the *Planets.*

V. *They have no Light of their own.* For the *Planets* being deſtitute of all *Light* of their own, ſhine only with borrowed *Rays*; and accordingly we find them only to be reſplendent on that ſide which faceth the *Sun*; whence we conclude, that they only reflect to our *Eyes* the *Rays* they receive from the *Sun.* This we experience in the *Earth*, *Mercury* and *Venus*, and all the *Secondary Planets*, which in *Eclipſes* are either wholly or in part obſcured, when they come within the Shadows of other *Planets*; and being out of the reach of them, do only ſpread a *Conical ſhadow* from their oppoſite part to the *Sun.* And we may believe the ſame of *Mars*, *Jupiter* and *Saturn*; which by how much nearer they are to the *Sun*, the greater *Light* do they caſt; and ſo much the weaker, as their diſtance is farther from it. The ſame is alſo manifeſt from hence, becauſe the *Light* of all the *Planets* is more dim, than that which is ſeen in the *Sun* and *fix'd Stars*; as likewiſe, becauſe there is not ſo vaſt a diſtance between them and the *Sun*, but that he can communicate his *Light* to them.

VI. *The Earth is to be accounted amongſt the Planets.* And we are to ſuppoſe the ſame of this *Earth* we inhabit, which being made up of *Opake Bodies*, does as ſtrongly reflect the *Sun*'s *Rays*, as the *Moon* doth. It is alſo ſurrounded with *Clouds*, which tho' they be leſs *Opake* than many other *Parts*, and therefore do not ſo ſtrongly reverberate the *Light*; yet we ſometimes ſee them cover'd with as bright a *Whiteneſs*, as the *Moon* it ſelf exhibits to us, when ſhe is illuſtrated by the *Sun.* The ſame is alſo confirm'd, for that when the *Moon* intervenes between the *Sun* and the *Earth*, we ſee that its Face doth reflect a kind of obſcure *Light*, which, as far as we can gueſs, muſt proceed from the *Earth*, which reflects the *Beams* it receives from the *Sun* to the *Moon.* Which obſcure *Light* ſenſibly decreaſeth, as the illuminated part of the *Earth* turns away from it.

VII. *The Planets are not perfectly Round.* Tho' it cannot be doubted, but that the *Planets* are *Spherical Bodies*, like the *Earth* (for if they were of a plain *figure*, they would in one and the ſame moment be totally enlightned;) yet are they not ſo perfectly Round, but that their *ſurface* is very rough and uneven. For we find by the help of *Teleſcopes*, that they abound with *Cavities* and *Eminences*, correſponding to our higheſt *Hills* and deepeſt *Valleys*, (as *GALILÆUS* tells us concerning the *Moon*, *Syſtem. Coſm. Dial. prim.*) many whereof are continued for a Tract of an hundred Miles together; others again are ſingle and compriz'd in one Heap. There appear alſo many ſteep and ſolitary *Rocks.* But the moſt frequent things to be ſeen there, are a kind of *Bulworks* (I call them ſo, becauſe no fitter word occurs) of conſiderable Height, which encompaſs Spaces of different *magnitude* and *figure*, the moſt frequent being *Circular.* Many whereof have in the midſt of them an *high Mountain*, and others ſeem to be filled with an obſcure *Matter*, like thoſe great *Spots*, which we may perceive in the *Moon.* From all which Particulars we conclude, that the *Moon* and the reſt of the *Planets*, are altogether like our *Earth*, which if a Man could behold from the *Moon*, would appear much as the *Moon* ſhews to us, who view it from the *Earth.*

VIII. *The Planets are not ſo ſolid as Comets.* We are in the next place to conſider how the *Planets* came to be, and what is the cauſe of their different Diſtance from the *Sun*, and from themſelves. This will be the more eaſily cleared, if we conſider, that the *Planets* are leſs ſolid than the *Comets*, and therefore are not toſt from one *Vortex* to another, but continue in that of the *Sun*; as ſmall *Boats* are driven about in a *Whirlpool*, or carried along with the Stream of a *River.* Whence we may apprehend, that the *Planets*, as ſoon as they were got into the *Sun*'s *Vortex*, began to ſink down towards the *Center*, till they met with thoſe *Cæleſtial Globuli*, whoſe *motion* was proportion'd with theirs. For ſeeing that the greater *Globuli* are more vehemently agitated, and withdraw themſelves farther from the *Center* of their *Vortex*, it could not be, but that by their puſhing againſt the *Planets* that are leſs ſolid, they muſt drive them towards the Midſt; and when the *Planets* were ſunk ſo low, that they met with thoſe *Globuli* that were inferiour to them in bigneſs and force of *motion*, they run back from the *Center*, till arriving to that place of the *Vortex* where they were in equal poiſe, they neither came nearer to the *Sun*, nor went farther from it; but hanging there equally poiſed between thoſe *Heavenly Globuli*, whirl'd continually about the *Sun.*

IX. *Of the firſt Production of Planets.* Wherefore we may imagin, that in that *Space* where we place the great *Vortex* of our *Heaven*, there were at the Beginning 14. or more *Vortexes*, the leſs whereof, and ſuch as were weakned by reaſon of their *Spots*, were ſwallowed up of the Greater; which at laſt, together with the Leſſer, fell into one common *Vortex*, *viz.* that of the *Sun.* So that the *Stars*, which in the *Centers* of the four ſmaller *Vortexes*, encompaſs'd *Jupiter*, betook themſelves to that *Planet*; and thoſe which were in the *Centers* of other *Vortexes* near to *Saturn*,

tended towards *Saturn*; as *Mercury*, *Venus*, the *Earth* and *Mars* tended towards the *Sun*. So that of so many *Stars*, all shining with their own light, the *Sun* only remained, whilst all the rest being covered with *Spots*, did not send forth light, but only reflect it.

X. *Why the Planets are at farther distance from, or nearer to the Sun.*

It appears from what hath been said, why the *Planets* do not equally recede from the *Center*, and at different distances are carried about the *Sun*; this being to be imputed to their different solidity. For the *Globe* of *Mercury*, by Example, is nearer to the *Sun* than that of *Venus*, and the *Globe* of the *Earth* nearer than that of *Mars*, for no other reason but because they are less solid.

XI. *What the Solidity of Bodies is.*

Now Solidity is nothing else, but the proper Quantity of a *Body* compared with its Bulk and Surface; which is not only estimated from the Closeness and Thickness of its parts, but also by its *Figure*, and especially from the less extent of its *Surface*. For *Bodies* of a less *Surface*, do more easily pierce other *Bodies*: and therefore the greater the quantity of *matter* is, under a less Bulk and *Surface*, the *more solid* that *Body* is. As appears in *Gold* and other *Metals*, which when once put in *motion*, have a greater force to continue the same, than more lax and open, or porous *Bodies* (as *Wood* and *Stone*) of the same Bigness and *Figure*; and therefore are esteemed more solid, that is, to have in them more *matter* of the Third *Element*, and less Pores filled with the First and Second *Element*. And this is the reason why *Mars*, tho' less than the *Earth*, yet is farther from the *Sun* than it, even because of its greater solidity.

XII. *The Planets differ in Solidity amongst themselves.*

The *Planets* therefore, as hath been said, according to their greater or lesser Solidity, are farther from, or nearer to the *Sun*. By reason of this greater Solidity, *Saturn* is most remote from the Sun, whose Motion, if it had been swifter, and his Solidity greater, he would have been forced out of his *Vortex*, and become a *Comet*. Next to Saturn is *Jupiter*, with his four *Secondary Planets*, which we suppose did fall down into his Neighbourhood, before that *Vortex*, whose *Center Jupiter* was, had been swallowed up by the great *Vortex* of our *Heaven*. After him follows *Mars*, who, because of the extension of his *Body*, that is, his Magnitude and *Figure*, is more solid than the *Earth*. Next to him is the *Earth*, surrounded with its own *Vortex*, about which the *Moon* is whirl'd in a Months time. For the *Moon* tending towards the *Earth* (as the *Jovial Planets* towards that *Planet*) was swallowed up of its *Vortex*. *Venus* is nearer the Sun than either the *Earth* or the *Moon*, but the neareſt of all is *Mercury*, as being the most solid of them all.

XIII. *The Planets are either Primary or Secondary.*

The *Planets* are divided into *Primary* and *Secondary*. *Primary Planets* are those that perform their *Periodical motion* only about the *Sun*, and not about any other *Planet*. *Secondary*, are such as are joined with another *Planet*, and together with it, are carried about the *Sun*. Thus the *Moon* is a *Secondary Planet* with regard to the *Earth*, the *Jovial Stars* with regard to *Jupiter*; and so are those other Stars that attend upon *Saturn*. By the *Astronomers* they are commonly called *Satellites*, or *Guards* of those *Planets* to which they belong.

CHAP. XIX.

Concerning the Principle of the Planets Motion, and of their Direction, Station and Retrogradation.

I. *Why the Planets are called Wandring Stars.*

SEeing that the *Heavens* are Fluid, and that the *Planets* do, as it were, swim in their Orbs, as in so many *Rivers*, it may be enquir'd what is the *Principle* of their *Motions*; as likewise what the cause is of those *wandering excursions*, whence the name of *Wandering Stars* hath been given them. Which name, we may believe, was therefore attributed to them; for that being carried about in the *Sun's Vortex*, they seem sometimes to approach nearer to, and sometimes to remove farther from one another; sometimes to ascend, and at other times to descend; sometimes to come nearer to the *Sun*, and at other times to withdraw at a greater distance from him. Whence arise the *Conjunctions* and *Oppositions* of the *Planets*, as likewise their *Aberrations* in *Longitude* and *Latitude*, so often inculcated by *Astronomers*. For tho' the *Planets* turn round about the *Sun*, yet do not they keep on their Course in the same direct *Line*, but do sometimes *ascend*, and at other times *descend*, as we see *wooden Bowls* do that *swim* in a *River*. And this their *Deflexion* is called *Aberration* in *Latitude*. Or else they are sometimes nearer the *Sun*, and sometimes farther from him; which are called *Aberrations* in *Longitude*. And this is the Reason, I say, why the *Planets* are call'd *Wandering Stars*, because they seem to roam at random, without keeping a steady course.

II. *The First Cause of the wandering motion of the Planets.*

This *wandering motion* of *Planets* may be attributed to several *Causes*. As *First*, to the *Figure* of those *Spaces* wherein they move; for these, not being perfectly Round, but spreading more in Length than Breadth, it must needs be that the *Heavenly Matter*, that carries them, must move more swiftly, where it is narrowly pent up, than where it hath a broader space to move in. As we see that the *Wind* blows with less force in an open *Field*, than where it is straitned in a narrow *Passage*; and as a *River* runs more swiftly where it is straitned in its course, than where the *Channel* is wider.

III. *The Second Cause.*

In the *second place*, for as much as these *Spaces* do touch one another, the *matter* of the First *Element*, passing from one space to another, doth according to the different *degree* of its *motion*, variously push forwards, and determine the *Globuli* of the Second *Element*, to drive the *Planets* more towards one part of *Heaven* than another. For the *matter* of the First *Element* being more swiftly moved, than the *Globuli* of the Second, it cannot but by pushing them forwards, move the *Planets* that are *poised* in the midst of them.

IV. *The Third Cause.*

Thirdly, This difference in the *motion* of *Planets*, sometimes ariseth from *themselves*, as when their *pores* are more fit to receive the *particles* of the *First Element*, proceeding from some Neighbouring *Body*, than others. Which sometimes also happens, when the *Pores* of *Planets* are more adapted to admit the *striate Particles*, which come driving from some certain part of the *Heaven*: For these *particles* being entred into the *Cavity* of the *Planets*, do variously agitate them, directing them towards those *places* to which they did tend. As the *Wind* turns a *Ship* to this or that part,

part, according as it penetrates the *pores* of the *Sails*, or other open passages of the *Vessel*.

V. *The Fourth Cause.*

Fourthly, The same *Motion* which in the beginning of the *World* was impress't upon the *Planets*, may be preserved to this instant, seeing that every *Body* continues in the same state, and is never changed but by *External Causes*. Thus a *Top* that is made to turn round by a Boy, hath a force to continue the same *motion* for some moments, notwithstanding the resistance it meets from the *Air* and the *Earth*. And accordingly we may believe that a *Planet* likewise hath a *power* to pursue the *motion* impress't upon it at the beginning, without any considerable loss of its swiftness; because the space of 5 or 6000 *years*, is a less time, compared with the vast *bulk* of a *Planet*, than one *minute*, compared with the littleness of a *Top*.

VI. *The Fifth Cause.*

In the last place we may add, That the *power* of continuing in its *motion* is more firm and steady in the *Planet*, than in the *Heavenly matter* that surrounds it; and in a greater *Planet* more than in a less. Because the *Globuli*, which are the parts of a *Fluid Body*, cannot so well conspire in the same *motion*, as the *Particles* of the *Third Element* do, which constitute the *Compact Body* of a *Planet*. Wherefore also it must be less obnoxious to those changes that happen to the *motion* of the *Celestial Globuli*, by how much the greater and compact it is.

VII. *The Periodical and Daily Motion of the Planets.*

Every *Planet* hath a twofold *Motion*; the first *Periodical*, whereby every one of the *Primary Planets*, together with its *Attendants*, is carried about the *Sun*: For that they are whirl'd about in their *Orbs* by the force of the *Solar matter*, appears from hence, because the nearer they are to the *Sun*, the sooner they absolve their *Circuit*: Not to mention now the *motion* of the *Spots* in the *Sun*, which, without doubt, proceeds from the *whirling* about of the *Solar matter*.

The other is the *Diurnal motion*, whereby a *Planet* seems in the space of 24 *hours* to move about the Earth from *East* to *West*. But this *Motion* doth not properly belong to the *Planets*, but is common to them with the *Comets* and *Fixt Stars*, by reason of the *Diurnal motion* of the *Earth*, as will appear hereafter.

VIII. *How the Planets are carried about by their Annual Motion.*

A *Planet* therefore is whirl'd about its *Center*, much after the same manner, as we see that a *Trencher* swimming in a large *Vessel* full of *Water*, that is swiftly whirl'd about, doth not only follow the circular *motion* of the *water*, but besides turns about its own *Center*. The Famous *CASSINUS* observed this in 1672. in the *Body* of *Jupiter*: for he having observed a *Spot* at $7\frac{1}{2}$. a *clock* in the evening in the midst of the *Belt*, he found at 5 a *clock* 26 *minutes* in the *morning*, that it was return'd precisely to the same place. And therefore from this and many other *observations*, he determined not only the Revolution of the *Spot*, but also of the *Body* of *Jupiter*, which he found to be performed in 9 *hours* 55 *minutes*, and 58 seconds; and the same was perceived by him not only in *Jupiter*, but also in *Mars*, *Venus* and *Mercury*.

IX. *The Cause of these two Motions.*

This twofold *motion* of the *Planets* ariseth from hence, because the *Cœlestial Globuli* that surround them, do not only carry them along their *Orbs*; but also because of the Propension they have, to pursue their *motion* in *Right lines*, they do more strongly exert their force upon their *External parts*, that are more remote from the *Sun*, than upon their *Inward parts* that are nearer to it: by which force they impress that *motion* upon it, which makes it whirl about its own *Center*.

X. *The Planets that are nearest to the Sun are most swiftly moved.*

The Consequence whereof is, that the *Inferior Planets*, or those that are nearer the *Sun*, must move more swiftly than the Higher. Because the *matter* of the *First Element*, which constitutes the *Sun*, by being swiftly whirl'd about, doth with a greater force drive along with it, the nearest parts of *Heaven*, than those which are more remote.

XI. *How it comes to pass that* Mercury *and* Venus *seem to turn about from* East *to* West *in* 24 *hours.*

These things presupposed, it will be an easie matter to explain the *motions* of the several *Planets*, and how it comes to pass that they seem to be carried from the *East* to the *West*. For supposing that the *Heavenly matter* that surrounds the *Sun*, is moved round it from *West* to *East*, and, without any interruption of its own Revolution, carries along with it the *Earth* about its *Center* in 24 hours; we shall easily conceive, that *Mercury* and *Venus* must appear to us to move from *East* to *West*, and every day to describe a *Circle Parallel* to the *Æquator*. And that they must likewise describe a *Circle* about the *Sun* from *West* to *East*, as being contained in the same matter, that carries the *Earth* round.

XII. *They must describe a great Circle.*

We shall also apprehend that these two *Planets*, as well as the *Earth*, must be found under the *Zodiack*, because it is the greatest *Circle*, which the *Celestial matter*, by which they are carried about, describes. For as much as according to the *Law* of *Nature*, every Body that is circularly moved, endeavours to recede from the *Center* of the *Circle* it describes.

XIII. *How it comes to pass that the Axis of the Earth observes its Parallelism*

It will also appear how the *Axis* of the *Earth*, which by its *Annual motion* is carried about the *Sun*, continues always *Parallel* to it self, or which is the same, how its *Poles* always respect the same *points* of the *Firmament*, *viz.* If we observe that the *Diurnal motion* of the *Globe* of the *Earth*, *Water* and *Air* doth determinate the subtil matter, which is in continual *motion* in the *Bowels* of the *Earth*, to go forth to the Plains *parallel* to the *Æquator*; and that at the same time, a like *quantity* of *matter*, proceeding from the parts of other *Vortexes* remote from the *Poles*, must enter into it by the *Poles*. For this supposed, it will easily be believed, that after the *Earth* hath once admitted the *Subtil matter*, coming to it from one part of the *Heaven*, its *pores* will thereby be the more fit to receive the like *matter* again, than any other proceding from other parts, as being more accommodate to it. And therefore it is no wonder, if those *Pores* which we apprehend to be *Parallel* to the *Axis* of the *Diurnal motion*, are so hollowed as to answer one another, and thereby give free admittance to the *subtil matter*. Which being granted, it is necessary that the *Poles* of the *Earth*, must always answer the same *points* in the *Firmament*, and its *Axis* observe a perpetual *Parallelism* to it self.

XIV. Mars, Jupiter *and* Saturn *are moved like the other Planets.*

And the same is to be said of *Mars*, *Jupiter* and *Saturn*: For seeing that these three *Planets* do seem so to run round the *Sun*, as that the *Circles* which they describe, do include the *Circle* of the *Earth*, we must admit that they are pois'd in the *Cœlestial matter* as well as the *Earth*, and are at a far greater distance from the *Sun*, than it is. In like manner we must confess that *Mars*, *Jupiter* and *Saturn*

Saturn must seem to run round the *Earth* from *East* to *West* in 24 *hours*, and to be carried away by the *Heavenly matter*, in the same manner as *Mercury*, *Venus* and the *Earth* are. Only with this Difference, that seeing their *Circles* are much greater than that of the *Earth*, so they employ a greater space of time in running through them. For whereas *Mercury* is whirl'd about the *Sun* in 3 Months, *Venus* in 8 Months, the *Earth* in a years time, *Mars* spends 2 years in his Revolution, *Jupiter* 12, and *Saturn* almost 30. For the distance between these three latter, and the *Sun* being greater, the *matter* which carries them, requires more time to run over those vastly greater *Spaces*.

XV. *How Planets come to be Direct, Stationary and Retrograde.*

From these various Courses of the *Earth* and *Planets* in their Revolutions about the *Sun*, it comes to pass that they appear to us on the *Earth* *Direct*, *Stationary* and *Retrograde*. For tho' their *motion* be continual, without any stop or *Retrogradation*, yet doth the *motion* of the *Earth* produce these various appearances, as oft as in its Revolution it intervenes betwixt the *Planets* and the *Sun*. Because when the *Earth* is whirl'd about the same way, swifter than the *Planets*, we must see them answering to divers parts of the *Heaven* of fixt *Stars*, and to be carried opposite to that part, whither we, together with the *Earth*, are carried.

XVI. *What Planets are said to be Direct, Stationary and Retrograde*

Those *Planets* therefore are called *Direct*, which pursue their Course according to the procession of the *Cœlestial Signs*; as from ♈ to ♉, from ♉ to ♊. *Planets* are said to be *Retrograde* when they proceed contrary to the Succession of the *Signs*; or which having first been moved towards the *East*, seem now to turn back towards the *West*: and those are called *Stationary*, which keep the same place under the *fixt Stars* for several days together. These *Stations* of the *Planets*, are observed before and after their *Retrogradations*, because the Determination of the *motion* of the *Earth*, doth deflect a little with respect to the Determination of the *motion* of the *Planets*, by which means the swiftness wherewith we are then snatcht away, doth only serve to advance us, as much as is needful, to behold that *Planet* which is Stationary, for several days together, under one and the same part of the *Firmament*.

XVII. *How Planets appear direct to us.*

The thing will be better apprehended by the *Figure*. Suppose we then the Sun placed in the midst of a *Circle*, about whom let us place the *Circle a d g k*, described by the *Annual motion* of the *Earth*. The other Higher *Circle* intersected by numeral *figures*, we suppose to be the *Orb* of some one *Planet*, viz. of *Mars*, *Jupiter* or *Saturn*, and the Circle N G A, to represent the *Heaven* of *Fixt Stars*. These things thus laid, let us suppose that the *Earth*, by its *Annual motion* is about the *Point a*, and that *Jupiter* is in that part of his *Circle* marked only by 1; then *Jupiter* will appear to those that dwell upon the *Earth*, in the part of the *Heaven* of *fixt Stars*, noted A, by the right *line*, *a* 1 A. Conceive we afterwards, the *Earth* to be advanced from *a* to *b*, and *Jupiter* from 1 to 2, at the same time; and *Jupiter* will appear to us to have moved on directly in the *Heaven*, according to the Order of the *Signs* from A to B; and when the *Earth* afterwards is advanced to *c*; and *Jupiter* to the part of his *Orb* 3, *Jupiter* will be seen advanced from B to C, alway keeping a Direct *motion*. And when afterwards the *Earth* is come to *d*, and *Jupiter* to 4, *Jupiter* will appear to have advanced by a direct *motion* from C to D. And when the *Earth* hath reached the *Point e*, and *Jupiter* 5, then *Jupiter* will appear to have moved from D to E, according to the order of the *Signs*.

Figure 28.

XVIII. *How they come to appear Stationary and Retrograde*

But when the *Earth* begins to be more directly interposed between *Jupiter* and the *Sun*, by that time the *Earth* comes to *f*, and *Jupiter* to 6, then will *Jupiter* appear to have gon back from E to F; and because this interval is very small, therefore he is said to be *Stationary*, because he appears unmoved and standing still. The *Earth* afterwards being advanced to the point *g*, and *Jupiter* to 7, *Jupiter* will appear to have moved *Retrograde* from F to G. Again when the *Earth* is come to *h*, and *Jupiter* to 8, he will appear to have past *Retrograde* from G to H. And lastly, when the *Earth* is come to *i*, and *Jupiter* to 9, he will seem to have moved *Retrograde* from H to I, which space being very small, *Jupiter* will again appear *Stationary*.

XIX. *How they come to appear direct again.*

Afterwards, when the *Earth* is advanced to *k*, and *Jupiter* to 10, he will seem to have proceeded directly, according to the Order of the *Signs*, from I to K. The *Earth* being come to *l*, and *Jupiter* to 11, he will seem to have pursued his Course directly from K to L. And lastly, when the *Earth* hath reached the Point *m*, and *Jupiter* 12, *Jupiter* will appear to have advanced directly from L to M.

XX. *The same may be shewed in like manner concerning* Saturn, Mars, Mercury *and* Venus, *but not of the* Moon.

The same may be demonstrated, not only concerning *Saturn* and *Mars*, but also concerning *Venus* and *Mercury*; which always appear *Stationary*, as oft as we remove from the opposite *Region* to the same; or from the same to the opposite *Region*; because the *Earth* is then so turned about, as to make them to be seen under the same *fixt Stars*, for some time together. These *Planets* appear *Retrograde*, when they are in opposition to the *Sun*, *Direct* when in *Conjunction*, and never so in any other *places*. But we are to observe, that *Retrogradations* are more frequently seen in *Saturn* than in *Jupiter*, and in him more frequent than in *Mars*, because of the slowness of *Saturn's motion*, which makes that the *Earth* in a shorter time doth overtake him. But on the other hand they are more rare in *Mars*, his *motion* being swifter than that of *Jupiter*, and consequently must spend more time to overtake him. But these *Affections* are not incident to the *Moon*, because she, in whatsoever part of the *Earth* we are, runs about us, as about her Center, her *Orb* being comprehended within the *Orb* which the *Earth* moves in.

CHAP. XX.

Of the Motion of the Moon, and its various Appearances, or Phases.

I. *The* Moon *is carried about in the same* Vortex *with the* Earth.

FOrasmuch as it is manifest from what hath been already said, that the *Moon* is not only carried about the *Sun*, but also about the *Earth*, and that there is only a small space between us and her; we may easily guess her to be contain'd in the same *Vortex* with the *Earth*. And consequently since the *matter* of this *Vortex*, doth whirl the *Earth* about its *Center* from *West* to *East*, we may

may conclude that it also carries the *Moon* along with it. But since the *Circle* which the *Moon* runs through, is almost 60 times bigger than the Compass of the *Earth*, we may gather, that if the *Earth*, by its diurnal *motion* is whirld about its *Center* in the space of 24 *Hours*, the *Moon* will not be able to finish her Revolution in less than about a *Months* space.

II. *The Moon may appear to move from West to East, or contrarily, within the space of one Month.*

This long time the *Moon* spends in her *Revolution*, is the Cause that she seems to run round the *Earth* every Day from *East* to *West*, whilst in the mean time the *Earth* turns round from *West* to *East*. Tho' this doth not hinder the *Moon* from appearing to run through all the *Signs* of our *Zodiack* from *West* to *East*.

III. *What the* Perigæum *and* Apogæum *of the Moon is.*

The *Moon* is sometimes nearer to the *Earth*, and that is her *Perigæum*; and at other times further from it, which is her *Apogæum*. This comes to pass, either because the Peculiar *Vortex* of the the *Earth* A B C D, is sometimes *bigger*, by reason of the *Matter* of the *First Heaven* more abundantly crowding into it; and at other times becomes *less*, because of the Expulsion of it again. Or else, because the *Moon* is more or less push'd on towards the *Earth*, by the various agitation of the *First Heaven*.

Figure 29.

IV. *The Moon advanceth swifter when she is New, than in her Quarters.*

The *Moon* seems to move swifter when *New* and *Full*, than at the *Quarters*. The Reason whereof is, for that her *Vortex* A B C D, by being press'd upon by the *Orbs* of *Venus* and *Mars*, between which it is placed, is thereby reduc'd to an *Elliptical* or *Oval Figure*. Hence it is that the *Cœlestial Matter* moves more swiftly in the narrow Parts B and D, of this *Elliptical Heaven*, and more slowly in the broader Spaces A and C; and therefore the *Moon*, in her *Conjunction* and *Opposition*, or at the *New* and *Full*, must be more swiftly carried about the *Earth* towards the *East*; because the Spaces it then runs through are more narrow, and do not suffer it to wander.

V. *Why the Moon is not exactly moved under the Æquator.*

If the whirling about of the small *Vortex* A B C D, which carries the *Moon* along with it, did only accord with the *Motion* of the *Earth*, then the *Moon* would appear to move under the *Æquator* from *West* to *East*; and on the contrary, if the *motion* of the said *Matter* should only agree with the *motion* of that great *Vortex*, which has the *Sun* for its *Center*, then it would only be seen under the *Ecliptick*. But seeing it is to agree with the *motion* of them both, it follows, that its *motion* must neither be under the *Æquator*, nor under the *Ecliptick*, but under another *Third Circle*, which comes nearer to the *Æquator*, than the *Ecliptick*; because the *Moon* is nearer to the *Matter* of the *Sun*'s *Vortex*, than to that of the *Earth*.

VI. *Above one half of the Moon is always illustrated by the Sun.*

The *Moon* being a *Round Body*, and receiving its Light from the *Sun*, it follows, that always one half of it, yea, somewhat more, must be enlightned by him. For seeing that the *Sun* exceeds the *Moon* in Bigness, and that the bigger *Sphere* always enlightens above half of a less, it does follow, that above one half of the *Body* of the *Moon* must always be illuminated. But seeing that the *Moon* alters her Position, and in running about the *Earth* doth variously face the *Sun*; it must needs be, that according to its various Access to, or Recess of the *Sun*, less or more of the illuminated Half will appear to us; which Variations of her *Appearance*, are commonly called her *Phases*.

VII. *The Conjunction of the Moon with the Sun is not to be accounted amongst her Phases.*

The *Philosophers* commonly reckon up four *Phases* of the *Moon*, according to the Fourfold respect which the *Moon* hath to the *Sun*, in different parts of the *Zodiack*. Whence it receives different Names; for the *Moon*'s meeting with the *Sun* in the same Degree of the *Zodiack*, is called the *Conjunction* or *New Moon*. Tho' it seems that the *Moons Conjunction* with the *Sun*, ought not to be accounted amongst her *Phases*; because the *Moon* at that time doth not appear to us at all, its enlightned part being wholly turn'd away from us, and its dark part turn'd towards us.

VIII. *The first Phasis of the Moon.*

The first *Phasis* therefore of the *Moon* is, when she being newly come from her *Conjunction* with the *Sun*, by moving in her *Orb* A B C D E F G H, reacheth B, whence she appears to us on the *Earth* I, *Horned* (or *Crescent-wise*) because of the *Hollowness* which is seen in her Illuminated part. Figure 30.

IX. *The second Phasis of the Moon.*

The second *Phasis* is, when the *Moon* about the *Seventh* or *Eighth day*, being 90 *Degrees* distant from the *Sun*, doth represent the full Half of her Enlightned part C, whose *Horns* or *Points* are directed to that part of *Heaven* which is opposite to the *Sun*, as from whence it receives its *Light*. and here she appears *Bisected*, or divided into two *Halves*.

X. *The third Phasis of the Moon.*

The third *Phasis* is, when the *Moon* D, advancing towards an *Opposition* with the *Sun*, exhibits to us more than one half of her Illuminated part, and therefore appears *Gibbous* or *Bunching out* on both sides.

XI. *The fourth Phasis.*

The fourth *Phasis* happens, when the *Moon* E being 180 *Degrees* distant from the *Sun*, and in *Opposition* to him, turns her whole Enlightned side towards us, who are placed betwixt the *Sun* and her.

XII. *The same Phasis happen to the Moon, when she is in the Wane.*

The same *Phasis* also belong to the *Moon* in Decrease, according to her various Aspects to the *Sun*. For when by going back she hath reach'd F, she appears *Gibbous*; when to G, *Half*; and at *H. Crescent-wise* again; till returning to A, her Enlightned part be wholly turn'd away from us towards the *Sun*.

XIII. *The Moon is more illuminated at the New, than at the Full Moon.*

The *Moon* is never less Enlightned than when she is at the *Full*, or in *Opposition* with the *Sun*; and never more than at the *New*, or when she is in *Conjunction* with the *Sun*; because when she is *Full*, only that part towards us is Enlightned: Whereas when *New*, she is wholly *illuminated*, that part which is then *towards us* being Enlightned by the *Earth*, and the other part that is turn'd *from us*, by the *Sun*. For the *Moon* doth not only borrow her *Light* from the *Sun*, but receives also some weak *illustration* from the *Earth*: Because the *Earth* being an *Opake Body*, must of necessity reflect part of her received *Light*; and forasmuch as the *Earth* is bigger than the *Moon*, consequently more *Light* must be deriv'd from the *Earth* to the *Moon*, than from the *Moon* to the *Earth*. This is confirm'd by Experience, because this *Secundary Light*, as *GALILÆUS* calls it, after the first *Quarter* quite vanisheth, by reason of the *Moon* being too far distant, and without those Bounds to which the reflected *Beams* from the *Earth* reach.

XIV. *The Moon is sometimes Enlightned from the Earth.*

We know likewise by Experience, that this *Light* is more perceptible when the *Moon* is *Eastward* from us, than when she is *West*. The Reason whereof is, because in the former situation, the *Light* is reflected to her from all the *Continent* of *Asia*, and part of *Africa*, which are more proper to reflect the *Sun-beams*, than those Seas which are towards the *West*. So that as the *Moon* doth at some times Enlighten the *Earth*; so at other times again, the *Earth* Enlightens the *Moon*.

XV. *What a Periodical and Synodical Lunar Month is.*

The *Moon* performs her *Revolution* in 27 *Days* and about 8 *Hours*; and this time is called the *Periodical Lunar Month*: And the time that intervenes betwixt the *Conjunction* of this *Planet* with the *Sun*, till the next *Conjunction*, is called the *Synodical Month*; which consists of 29 *Days*, and about 12 *Hours*. Wherefore, when on a certain *Day* there is a *Conjunction* between the *Moon* and the *Sun*, the *Moon* indeed will return to the same *Degree* of the *Zodiack*, at the end of 27 *Days* and near 8 *Hours*; but she will not meet with the *Sun* there, who by this time will be advanced 27 *Degrees* further to the *East*; so that the *Moon* will be fain to proceed two *Days* longer before she can overtake him.

CHAP. XXI.

Of the Eclipses of the Sun and Moon.

I. *What an Eclipse of the Sun is.*

FOrasmuch as the *Earth* by its *Annual Motion*, turns round about the *Sun*; and the *Moon* by her *Monthly Revolution*, is whirl'd about the *Earth*, it cannot be but that the *Earth*, *Sun* and *Moon* must sometimes meet, and be oppos'd to one another. Whence, if it so happens, that by the *Moons* intervening betwixt the *Sun* and the *Earth*, the *Sun* becomes obscured by her *shadow*, this we call an *Eclipse* of the *Sun*, because its *Light* is hindred from being diffused on the *Earth*. So that the *Eclipse* of the *Sun*, is nothing else, but *a Failing of Light in some Region of the World, caused by the Diametrical Interposition of the Moon betwixt the Sun and that Country*. Wherefore this *Eclipse* always happens at the Time of the *Moons Conjunction* with the *Sun*.

II. *What an Eclipse of the Moon is.*

But if the *Moon* come within the verge of the *Earths shadow*, and by this means be deprived of the *Light* it borrows of the *Sun*, this we call an *Eclipse* of the *Moon*. And accordingly, *an Eclipse of the Moon is a Failure of Light in the Moon, because of the Diametrical Interposition of the Earth between the Sun and the Moon*. For then is the *Moon* obscured by the *shadow* of the *Earth*, and it happens always at the *Full Moon*, or *Opposition*: Tho' this Observation be not perceiv'd by all the *Inhabitants* of the *Earth*; but by those only that are in that part of the *Earth*, which is Diametrically interpos'd between the *Sun* and *Moon*.

III. *An Eclipse of the Moon is either Total or Partial.*

An *Eclipse* of the *Moon* is either Total, or Partial. A *Total Eclipse* is, when the whole Round of the *Moon* is cover'd with the *Shadow* of the *Earth*: Whereas in a *Partial*, a part of it only is obscured.

IV. *A Solar Eclipse may more properly be called an Eclipse of the Earth.*

Betwixt these two *Eclipses* we are to observe this considerable difference, that the *Failure* of *Light* in the *Moon*, is caused by the Interposition of the *Earth*, which really keeps off the *Sun's Rays* from it, hindring it from receiving its wonted splendour. But no such *Defect* of *Light* ever happens to the *Body* of the *Sun*, whose *Light* cannot be the least impair'd, because of the *Moons* Interposition between him and the *Earth*. And therefore an *Eclipse* of the *Sun*, may with more propriety of Speech be called an *Eclipse* of the *Earth*, the Defect of *Light* being only in Appearance in the *Sun*, but really and indeed in the *Earth*, which is then deprived in a greater or less degree of his *Light*.

V. *What the Head and Tail of the Dragon is.*

We are to observe that, as the way of the *Sun*, or the *Ecliptick*, doth obliquely intersect the *Æquator* in the two opposite *Æquinoctial Points*; so likewise the *Orb* of the *Moon* is not directly under the *Ecliptick*, but cuts the same in two opposite Points at *Oblique Angles*; and these *Points* are called the *Nodes*, or the *Dragons Head* and *Tail*. For the clearer conceiving whereof we are to note, that the *Ecliptick* divides the *World* into two Parts, whereof that which contains the *Northern Pole*, is called the *Northern part*; as that which contains the opposite *Pole*, the *South part*. This supposed, we say that the *Dragons Head* is one of the Common Sections of the *Ecliptick*, as well as of the *Circle* which the *Moon* describes, when she passeth from the *South part* of the *World* to the *North*; and the other Section, by which the *Moon* passeth from the *North* to the *South part* of the *World*, is the *Tail* of the *Dragon*. The *Orb* of the *Moon* therefore, A B C D, doth not concur with the *Sun's Ecliptick* A E C F, but intersects the same in two places, at A and C. In or very near which Intersections the *Sun* and *Moon* must be, or else no *Eclipse* can happen. For beyond the *Ecliptical Terms* G H I K, there are no *Eclipses*; because every where else the *Moon* is either too high towards the *North* B, or too much depress'd towards the *South* D; so that where there is not a *Conjunction*, or an *Opposition* of these *three Bodies*, the *Sun*, *Moon*, and the *Earth*, at the *New* or *Full* of the *Moon*, neither *Solar* nor *Lunar Eclipse* can ever happen. Figure 31.

VI. *The Eclipse of the Sun ever happens at the New of the Moon.*

Wherefore we see, that the *Eclipse* of the *Sun* can only happen at the *New Moon*, when the *Sun* and *Moon* are in *Conjunction*. For since the *Orb* of the *Moon* only intersects the *Ecliptick* at two *Points* or *Nodes*, she must of necessity be found in one of these before she can cause an *Eclipse*. And forasmuch as the *Sun* meets twice only in a Year with the *Moon*, in or at those *Nodes*, the *Sun* cannot suffer an *Eclipse* more frequently, than about every sixth Month. The *Moons motion* also from *West* to *East*, being not always exactly under the *Ecliptick*, but deviating something from it towards the North or South, and consequently not moving directly between the *Sun* and us, it is apparent that no *Eclipse* can be, but when the *Sun* and *Moon* are together in the *Dragons Head* or *Tail*, which, as I said, happens but every *sixth Month*.

VII. *The Eclipse of the Moon happens only at the Full, tho' not at every Full Moon.*

Accordingly the *Eclipse* of the *Moon* happens, when the *Earth a*, being directly interpos'd between the *Moon b* or *d*, and the *Sun c*, doth by its *Conical shadow 1 h i*, hinder the direct *Rays* of the *Sun* from reaching any part of the *Body* of the *Moon*, as in *b* and *d*, or only from illuminating some part

Figure 32. part of it, as in *e* and *f*. The *Eclipses* of the *Moon* are only at the *Full Moon*, that is, whilst the *Sun* and the *Moon* are diametrically oppos'd in the *Dragons Head* and *Tail*; because then the *Earth* comes between them, and by its *Shadow* does obscure the *Moon*. Yet it doth not follow from hence, that there must be *Lunar Eclipses* every *Full Moon*; because the *Moon* having some *Latitude*, she is often at the time of her Opposition to the *Sun*, at a considerable distance from the *Nodes*, whence it happens that the *Shadow* of the *Earth* does not touch her; there being no possibility of an *Eclipse*, except the *Sun* and *Moon* be in the *Head* and *Tail* of the *Dragon*. And forasmuch as the *Sun* cannot be there above twice in a Year, it is evident, that we cannot have a *Lunar Eclipse* every *Full Moon*.

VIII. *The Cause of a Total and Partial Eclipse.* A *Total*, or *Partial Eclipse* is caused, when the *Luminaries* are in *Opposition*, as in the *Lunar*; or in *Conjunction*, as in the *Solar Eclipse*, in or near the *Nodes*, or else at a little distance from them: For seeing that the *Axis* of the *Earths Shadow* is always in the Plain of the *Ecliptick*, it cannot be otherwise, but that when this *Axis* coincides with the *Nodes*, the *Moon* passing that way, or near to it, must be wholly dipp'd in the *Shadow* of the *Earth*; but when more remote, then the *Moon* must be only in part obscured, as entring only into the verge or brim of the *Shadow*. And so likewise in the same manner, because the *Axis* of the *Lunar Shadow*, the *Sun* being behind it, doth then appear, when the *Moon* is in the *Ecliptick* or *Node*: Therefore it is necessary, that at that time when it doth not appear less than the *Sun*, it must cover the whole *Sun*, which otherwise covers only some part of it; *viz.* when the *Axis* of that *Shadow* being somewhat turn'd aside from our Sight, a part of the *Moon* only comes between us and the *Sun*.

IX. *A Total Eclipse of the Sun happens very rarely, and when it does, lasts only for a Moment.* A *Total Eclipse* of the *Sun* is a thing seldom seen; for the *Moon* being much less than the *Earth*, cannot but rarely be so conjoyn'd with the *Sun*, as to cover its whole Round, and hinder the *Light* proceeding from it to reach the *Earth*; but only so, as to cover some part of it with its *Shadow*. Besides, forasmuch as the *motion* of the *Sun* from *West* to *East* is very swift, she makes haste away from under the *Sun*, and therefore can only obscure it for a very short time. So that tho' we should suppose the *Moon* to be so conjoyn'd with the *Sun*, that his *Light* might appear to be totally intercepted; yet could not the Failure of *Light* last above a Moment, seeing that in the next following Moment, some of its *Light* would be diffused from that part of the *Sun*'s *Body*, which by that time would be got out of the *Shadow*.

X. *Eclipses appear various in various Parts of the Earth.* Thus it often happens, that tho' a *Total Eclipse* be perceived in some part of the *Earth*, yet in other parts the same is only *Partial*, and in other again *none at all*. This will clearly appear in the *Scheme* or *Figure*, where the *Moon a*, being interpos'd between the *Sun b*, and the *Earth c*; it is manifest that the *Inhabitants* at the Point *d* will be deprived of the whole aspect of the *Sun*, because of the interposition of the *Moon*; they who dwell at the Point *e*, will be depriv'd of the one half of it; whereas no part of the *Sun* will be obscur'd to them who live at *f*; and the same is to be understood of all other the Inhabitants of the *Earth*, from whom the *Moon* turns away the *Sun-beams* more or less, according to their several situations.

Figure 33.

This acquaints us with the Reason, why a *Lunar Eclipse* is perceiv'd in one and the same manner, by all those that are in the same *Hemisphere*, and have the *Moon* above their *Horizon*; but not the *Eclipse* of the *Sun*, which appears to some *Total*, to others *Partial*, and to others again *None at all*.

XI. *Why the Eclipse of the Sun never appears Total to all the Inhabitants of the Earth.* For the *Moon* being destitute of all *Light* of her own, must needs be perceiv'd alike obscur'd by all: Whereas the *Sun*, being *Lucid* of it self, cannot appear destitute of all *Light*, but only so far as it is cover'd by the *Globe* of the *Moon*, which intervenes between the *Sun* and the *Earth*; and forasmuch as the *Lunar Globe* is less than the *Sun*, or the *Earth*, it can no otherwise happen, but that some part of the *Earth*, to which the *Moon* appears equal to the *Sun*, or greater, must be depriv'd of the whole *Light* of it; whereas others, to whom it appears otherwise, are but deprived of the Half, or of more or less of its *Light*, and others again enjoy the whole *Light* of it.

XII. *Eclipses of the Sun are less frequent, than those of the Moon.* The *Solar Eclipses* are not so frequent as the *Lunar*; for the *Body* of the *Moon*, which deprives us of the *Sun-beams*, being much less than the *Earth*, which deprives the *Moon* of *Light*, it cannot be otherwise, but that the *Moon* must more frequently meet with the *shadow* of the *Earth*, than our *Sight* meets with the *shadow* of the *Moon*. But this is not to be understood of the whole Round of the *Earth*, but only with respect to some determinate *Part* of it, as by *Example*, that place where we live: For otherwise there is no question, that every six Months *Solar Eclipses* happen in this or the other part of the *Earth*, and no less frequent than the *Lunar Eclipses*.

XIII. *How long the greatest Eclipse of the Sun lasteth.* The Duration of *Eclipses* is not always the same. If it be enquir'd, what the greatest Duration of a *Solar Eclipse* is; *GASSENDUS* in his *Astronomical Institution*, determines it to be the Space of about 2 *Hours*. For seeing that the *Moon* spends a whole *Hour* from the time that she hath made a beginning of the *Eclipse*, by touching the Western brim of the *Sun*, with her Eastern, until the time that the same brim come to the Eastern part of the *Sun*, and thereby make the midst of the *Eclipse*; and because then only the Western brim of the *Moon*, is advanced to the Western brim of the *Sun*, which soon after it quits wholly: So that as soon as the Incidence ceaseth, the Emersion begins; it necessarily follows, that she must spend another *Hour*, before the same brim can reach the Oriental part of the *Sun* again, and wholly quitting it, put an end to the *Eclipse*.

XIV. *Why the Superiour Planets are not subject to be Eclipsed.* The *Superiour Planets* suffer no *Eclipses*, when the *Earth* comes between them and the *Sun*; because the *Conical shadow* of the *Earth* cannot reach them. Yet those *Planets* that have any Assistant *Stars*, are subject to *Eclipses* by their Interposition, as is evident from Observations about *Jupiter* and *Saturn*.

CHAP.

CHAP. XXII.
Of the Fixed Stars.

I. *What the Fixt Stars are.*

THE *Fixed Stars* are ſo called, not becauſe they reſt without any *motion* at all, or becauſe they are faſtned to the *Heaven*, as ſo many *Nails*, but becauſe, being ſeated in the *Center* of their ſeveral *Vortexes*, they always keep the ſame *ſituation* and diſtance from one another. So that the *Fixt Stars are Lucid Bodies, conſiſting of the matter of the Firſt Element flowing to the Center of the Vortex, and ſucceeding in the room of the Globuli that recede from thence, giving forth light from themſelves, and much differing in Magnitude from each other.*

II. *The Fixt Stars are higher than the Planets.*

Tho' there ſeem to be an immenſe diſtance between us and the *Planets*, yet is the ſpace that reacheth from the *Earth* to the *Fixt Stars*, much greater, becauſe the *Planets* do ſometimes hide the *Fixt Stars*, which they could not do, if they were not interpos'd between us and them, and conſequently lower than the *Fixt Stars*. Moreover, foraſmuch as the *Aſtronomers* have not as yet found out any thing, whereby to meaſure this vaſt diſtance, we may ſuppoſe it to be as great as we pleaſe.

III. *How the Aſtronomers find out that the Fixt Stars are higher than the Planets.*

That the *Fixt Stars* are higher than the *Planets*, the *Aſtronomers* prove from the *Parallax* or Commutation of our Sight. They conceive two *lines*, the one drawn from the *Center* of the *Earth*, the other from its *Surface*, or from the *Eye* of the *Spectator*, through the *Center* of a *Planet*, and reaching to the *Firmament* beyond it. That which is drawn from the *Center* of the *Earth*, will be higheſt; whereas that which is drawn from the Eye of the *Beholder* is lower and more depreſt, unleſs when they both end in the ſame Vertical Point. And foraſmuch as the *Point*, in which the Firſt *Line* is terminated, is accounted to be the true *place of the Planet*, and the Point in which the other line ends, the Apparent or *ſeen place* of the *Planet*, it is eaſily apprehended, what the *Parallax* is, *viz.* the difference or diſtance that is found betwixt both theſe *places*. Foraſmuch therefore as there is no *Planet* that hath not ſome *Parallax*, the *Aſtronomers* infer, that the *Region* of the *Fixt Stars* is at a greater diſtance from the *Earth* than any of the *Planets*. For there would be no *Parallax* or change of the Sight, in caſe any *Planet* were as far from the *Earth*, as the *Fixt Stars*.

IV. *The Sun is the greateſt of all the Fixt Stars as to our ſight.*

The *Sun* is the greateſt of all the *Fixt Stars* as to us, for that by reaſon of his nearneſs to us, he doth more ſtrongly move the *Luminous matter*; for there is no queſtion, but that if the *Sun* were beheld from the *Fixt Stars*, it would not appear any greater than they do. Yea, *GALILÆUS* gathers that the *Fixt Stars* themſelves, have greater appearing *Diameters*, their immenſe diſtance conſidered, than agrees with the common *Aſtronomical Calculations*, becauſe if we take away their *Beams*, the *Diameters* of the *Fixt Stars* by this means become much leſs.

V. *Some Fixt Stars are higher than others.*

All the *Fixt Stars* are not placed in the Circumference of one *Sphere*, as ſome have imagined, by giving too much credit to their *Senſes*; but as the *Sun* hath a ſpace about it, in which no *Fixt Star* is contained; ſo likewiſe every *Fixt Star* muſt be ſuppoſed to be at a vaſt diſtance from any other, and ſome of them at far greater diſtance from *us* and the *Sun*, than others of them. So that the inequality which is diſcerned to be betwixt the *Fixt Stars*, will be as much from their greater or leſs *diſtance*, as from the greater or leſs *Bulk* of their *Bodies*. And tho' the *Region* wherein the *Fixt Stars* are, appear *Spherical* to our Eye, yet would it be irrational to undertake to determine any thing concerning the *figure* of any *Body*, whoſe outward and inward Surface cannot be diſcovered by us.

VI. *Why the Fixt Stars appear to be in the ſame plain.*

For it is notorious, that *Bodies* of equal bigneſs, by reaſon of their unequal diſtances, appear to be unequal. Now to ſuppoſe all the *Fixt Stars* to be in one Plane, is not ſo much as probable, neither is there any reaſon to prove it: for tho' they be at vaſt diſtances from one another (which we boldly do aſſert) yet will they ſeem to be in one and the ſame Plain, after the ſame manner as *Planets*, *Fixt Stars* and *Clouds* ſeem to be in the ſame Plain, yea, and to touch the very *Horizon*, becauſe there is nothing interpoſed between them, and our ſight, whereby we may judge of their *diſtance*: And I durſt lay it down for a general *Rule*, that *all diſtance vaniſheth, where we have no* Senſe *nor Judgment of the intervening Bodies.*

VII. *The Fixt Stars ſhine with a Light of their own.*

The *Fixt Stars* have a light of their own, as we have ſhewed in the foregoing part of this *Diſcourſe*, that the *Sun* hath, whom we take to be one of the *Fixt Stars*; there being no other *Lucid Body* whence he might borrow his *Light*, in caſe he had it not in himſelf. And the ſame is evident alſo concerning the reſt of the *Fixt Stars*, from the briskneſs of their *Beams*, and their vaſt diſtance both from us, and from the *Body* of the *Sun*, ſo that they cannot borrow any part of his *Light*. For we frequently perceive the *Body* of the *Sun*, covered with *Spots*, which like ſo many *Clouds* cover his Face, and by reſting the Preſſure of the *Light*, ſuffer only ſome languid *Beams* to proceed from him to us; and this, as *Hiſtorians* tell us, hath ſometimes continued for a whole year together, and hath made the *Sun* all that while to appear with a pale whitiſh Light, like that of the *Moon*: And yet the *Fixt Stars*, during this time, were never found to have loſt any thing of their *Light*; which muſt have followed in caſe they had received their *Light* from the *Sun*.

VIII. *The Fixt Stars are at too great a diſtance from the Sun to receive any Light from him.*

Again, that the *Fixt Stars* are of a *fiery Nature*, and like the *Sun*, ſhine with their own *Light*, may be thus proved; becauſe if the *Sun* ſhould be viewed from the *Fixt Stars*, it would appear no greater than one of the leaſt of them; and therefore if the *Sun* were removed from us, as far as they are, its bulk would appear ſo much leſſened, as ſcarcely to be conſpicuous. And again, if we ſhould ſuppoſe the *Dog-Star*, to be placed where the *Sun* now is, it would appear as great and glorious as the *Sun* now appears to us. Now this vaſt diſtance of the *Sun* from the *Fixt Stars*, ſufficiently proves that it is impoſſible they ſhould borrow their *Light* from him. Wherefore we muſt conclude, that the *Light* of the *Fixt Stars*, doth not at all differ in nature from that of the *Sun*, as conſiſting only, on their part, in the ſwift agitation of the matter of the *Firſt Element*; and with reſpect to the *Medium*, in the *motion* they communicate to the *Globuli* of the *Second Element*, intervening between thoſe *Stars* and us.

All

IX. *Why the Fixt Stars twinckle.* All the *Fixt Stars* do seem to *Twinckle*, the reason whereof is the strength and briskness of their Rays, whereby they strike upon our Eyes. Which appears from hence, that when we look upon them through a *Telescope*, their *Twinckling* is much diminished, the strength of their *Rays* being much weakned, by passing through the small holes thereof. Another cause of their Twinckling is, because their *Vortexes*, which on every side encompass our *Heaven*, are not perfectly round, but have irregular Surfaces, as may be seen in *Figure* 20: whereby it happens, that whirling about their *Centers*, and acting upon our *Heaven*, the *Rays* of the *Stars* come to fall obliquely upon it, and by that means are refracted; from which *Refraction* their Scintillation or Twinckling follows. The said Scintillation may also be caused by the agitation of *Vapours* and *Exhalations* in the *Air*; as we see little *Pebbles* that lie without any *motion* at the bottom of a *River*, do seem to shake, by reason of the continual *flowing* of the *Water*.

X. *How it comes to pass that the Stars do not appear in their own places.* For the same reason also it is that the *Fixt Stars*, are not seen by us in the same places, wherein they are indeed, but as if they were placed in the surface of our *Great Vortex*, which hath the *Sun* for its *Center*. And here they cannot appear in their own places, because the Surfaces are in a manner, never so disposed, that the *Rays* which pass through them, from these *Stars* to the *Earth*, do meet with them at *Right Angles*; for when they meet with them *obliquely*, it is necessary, according to the *Rules of Refraction*, that they must bend a little, because they pass more easily, by one of the sides of these *surfaces*, than by the other.

XI. *The Fixt Stars seem to move.* Tho' the *fixt Stars* are contained in their *Vortexes*, and always keep the same distance from one another, yet they seem to move, not only by a *Diurnal motion*, by reason of the *Earths Revolution* about its own *Center*; but also by another *motion*, according to which every *Star* seems to encrease its *Longitude*; ever since that time, when *HIPPARCHUS* 130 years before *Christ*, observed that the *Fixt Stars* had a *motion* like the *Planets*, from *West* to *East*; having taken occasion for making this Discovery from some observation of *TIMOCHARIS* and *ARISTILLUS*. For when *TIMOCHARIS*, amongst other *Stars*, had observed, that the *Spica Virginis*, was almost 8 *degrees* antecedently distant from the point of the *Autumnal Æquinox*, He found the same *Star* to be only removed six degrees from the said point. From which observation he concluded, that they move by this *motion* about one degree, in the time of 100 years; and consequently that the *Fixt Stars* also had a *motion* of their own.

XII. *What the cause is of this appearing motion.* In order to the Explication of this appearing *motion* of the *Fixt Stars*, we are to suppose, that the *Axis* of the *Diurnal motion* of the *Earth*, doth not accurately keep the same *Parallelism* in its *Annual Revolution* which it had before, but somewhat turns aside from the same, after the running out of a great many *years*; and tho' this *Deflexion* from the *Axis* of the *Ecliptick* be insensible; yet the *Earth*, by this *Reeling motion*, in the space of many thousand *years*, is the cause that its *Poles* describe a *small Circle* from the *East* to the *West*. And since that according to this *Hypothesis* we conceive the *Æquator of the Earth* to answer to different parts of the *Heaven*, it follows that the *Cœlestial Æquator* must also change its place, and cut the *Ecliptick* at divers *Points*, from *East* to *West*. And because the *Longitude* of the *Fixt Stars* is computed from that time, in which these two *Circles* are intersected, it cannot be, but that the said *Longitude* must seem to be encreased every hundred years.

XIII. *Why the Poles of the Earth are by little and little obliquely turned the contrary way to its Annual motion.* This will appear more manifestly, if we suppose that the *Declination* of the *Axis of the Earth* from the *Perpendicular* to the Plain of the *Ecliptick*, proceeds from the *Striate* Matter of the First *Element* (as shall be explained more at large in the sixth Part) which coming from that part of the Second *Heaven*, which is 23 degrees distant from the *Poles* of the First *Heaven*, and passing through its *Poles*, doth incline it to so many *degrees*. But because that part of the Second *Heaven*, which is fit and dispos'd, to drive the *Striate Matter* into the *Poles* of the *Earth*, and by this means to sway them obliquely, is insensibly turned round from 1 to 2, and from 5 to 6, and so on, according to the trace of the *Polar Circles* 1, 2, 3, 4, and 5, 6, 7, 8, which in this our age, are 23 *degrees* distant from the *Poles* of our First *Heaven* A C; whilst, in the mean time, the *Earth*, together with the rest of the *Planets* is moved in its *Annual motion*, according to the Succession of the *Signs* of the *Zodiack* from *Aries* ♈ to *Taurus* ♉, and from *Taurus* to *Gemini* ♊, and so on, by a contrary *Motion* to that of the Second *Heaven*, that communicates the *Striate Matter* to the *Earth*; by this means it comes to pass that the *Poles* of the *Earth* are by little and little turn'd about, respecting those *Polar Circles* at this time, with an inclination of 23 *degrees*, contrary to the course of their *Annual Motion*: So that the *Poles* of the *Earth*, which were directed to the parts of the *Polar Circles* marked N O, are now directed, to those parts of them that are marked L M. Figure 34.

Neither only is that part of the Second *Heaven*, which sends the *Striate Matter* to the *Poles* of the *Earth*, and directs or inclines them according to the trace of the *Polar Circles* 1, 2, 3, 4, and 5, 6, 7, 8, swayed about, but it is also lifted up to the *Poles* A C, of our *Heaven*, and is again by them, in that wresting about, softly depressed. And this is the Cause, why the *Axis* of the *Poles* of the *Earth* I, doth now decline 23 *degrees* and 30 *minutes*, according to the magnitude, for Example, of the *Line* L M, or N O, from the *Poles* A C, of our *Heaven*, whereas formerly this *Declination* was of whole 24 *degrees*.

XIV. *The Longitude of the Fixt Stars may be unequal.* Wherefore altho' the *change* which happens to the *Longitude* of one *Star*, cannot but be like to that which happens to another; yet it is not necessary, that all the *Fixt Stars* together, should throughout all *Ages* obtain the same *Longitude*, since it is possible that this *Reeling* of the *Earth*, may be more sensible in this Age than in another. And therefore the Irregularity of the Apparent *motion* of the *Fixt Stars*, may be easily explained, by supposing, that the *Reeling* or Titubation of the *Earth* is not *Regular*; and that in some *Ages* it deflects somewhat more, and in others less.

XV. *How the Change of the Declination of the Ecliptick is made.* We may likewise easily comprehend, that the apparent *Ecliptick*, must somewhat alter its *declination*, provided we conceive, that during this *Titubation*

tubation of the *Earth*, its *Axis* inclines towards the plain of the *Ecliptick*, somewhat more at one time than another; for thus the *Æquator* of the *Earth*, determines that of the *Heaven*, in parts that are at such different Distances from the *Ecliptick*. Now this *Reeling motion* of the *Earth*, follows necessarily from its being placed in the *Vortex* of the *Sun*: For it would be a great wonder, if being plac'd in the midst of a *Liquid matter*, as it is, it should continue there many Ages, without admitting any change in its situation.

XVI. *Why the Fix'd Stars are not seen in the Day time.*

The *Fix'd Stars* are not seen by us in the day time, because the impression of the *Sun*'s *Brightness* is so strong on our *Eyes*, that the *Light* of the *fix'd Stars* cannot make it self perceptible. The case is the same, as when our *Ear* being stun'd with some great Noise, cannot perceive any low or weak sound: Or, as a *hot Hand* cannot distinguish the less sensible warmth that is in another *Subject*. Yet doth not this hinder, but that a *Man* plac'd at the bottom of a *Well*, may perceive the Light of the *fix'd Stars*; because there his *Eye* is not so strongly affected by the splendour of the *Sun*; neither doth any thing hinder a *Star* that is above the *Horizon*, from freely transmitting his *Rays*.

CHAP. XXIII.

Of the Asterisms and Constellations.

I. *The Number of the fix'd Stars.*

THo' the *Fix'd Stars* be dispers'd throughout the immense Space of *Heaven*, and can no more be numbred than the *Sand* on the *Sea-shoar*; yet the *Astronomers* have been pleased to determine a certain Number of them, which they have discover'd by the help of their *Telescopes*, as being nearer to us, and more in view. Of these they count 1022; which they have divided into 6 *Classes* or *Ranks*.

II. *The difference of the Magnitude of the Stars.*

The greatest *Stars* of all are called, *Stars of the First Magnitude*; and of these there are 15.

The next to these are called, *Stars of the Second Magnitude*, of which there are 45.

After these follow those that are of the *Third Magnitude*, being 208 in number.

Of the *Fourth Magnitude*, there are 474.

The fifth *Classis* of *Stars*, are those of the *Fifth Magnitude*; and of these there are 217.

The sixth *Rank* or *Order* of *Stars* contains 49, and are the least of all. To which, for the making up of the Number, 9 *Stars* called *Obscure*, are added, and 5 called *Misty* or *Cloudy*, because they can hardly be perceived.

III. *All the Stars that belong to one of these Orders, are not equal.*

It is to be observ'd, that all the *Stars* that are of one *Classis*, do not appear to us of the same Bigness and Brightness; but in every one of these *Divisions*, there are some that are Greater, some Less, and some of a Midling-size, between both. For the *Dog-Star* is the biggest of them all; and tho' the *Lyre* or *Harp* be of a very conspicuous Magnitude, yet can it not be compared with it; and the same may be said of the other *Orders* or *Divisions*. For the *Eye of the Bull* doth far exceed the *Lions-Heart*, and the *Virgins Ear of Corn*.

IV. *How the Stars came by their several Names.*

To the end these *Stars* might be the better distinguish'd and remembred, the *Astronomers* have reduc'd them to certain *Constellations*, and affixed some *Signs* or *Figures* to them, according as they imagin'd them to have some resemblance or agreement with such and such *Animals* or *things*.

V. *The Number and Character of the Constellations in the Zodiack.*

The *Astronomers* reckon up 48 of these *Figures* or *Constellations*, whereof some are in the *Zodiack*, others without it in the Northern and Southern *Hemisphere*.

In the *Zodiack* are 12 *Constellations*: *Aries*, or the *Ram*, expres'd by this Character ♈, as representing the *Head* and *Horns* of a *Ram*: *Taurus*, ♉, the *Bull*, the *Head* and *Horns* of an *Ox*: *Gemini*, or *Twins*, ♊, two *Bodies*, with their *Arms* and *Legs* twisted together: *Cancer*, the *Crab*, ♋, the *Claws* of a *Crab*, with their Retrograde going: *Leo*, the *Lion*, ♌, representing a *Lion*'s *Tail*: *Virgo*, the *Virgin*, ♍, resembling a *Wing*, or the *folded Gown* of a *Damsel*: *Libra*, the *Balance*, ♎, the *Beam* of a pair of *Scales*: *Scorpius*, the *Scorpion*, ♏, the *Body* and *Tail* of a *Scorpion*: *Sagittarius*, the *Archer*, ♐, an *Arrow*, apply'd to a *Bow*: *Capricornus*, ♑, the *Head* and *Horns* of a *Goat*, with the *Tail* of a *Fish*: *Aquarius*, the *Waterman*, ♒, the pouring of *Water* out of a *Pitcher*: *Pisces*, the *Fishes*, ♓, two *Fishes* tied together with a String.

VI. *Each Sign contains 30 Degrees.*

The *Astronomers* attribute to each *Sign* of the *Zodiack* 30 *Degrees*, tho' the *Asterisms* themselves be unequal, some of them being shorter, and others longer: For if 360 be divided by 12, the result will be 30.

VII. *What are the most conspicuous Stars in every Sign, and first in* Aries.

In ARIES 3 *Stars* are most conspicuous, 2 in the *left Horn* of the *fourth Magnitude*, and 1 of the *third*, between the *Horns*; which *Tycho* calls the *Bright Star* in the top of the *Rams Head*.

VIII. *What in* Taurus.

The most considerable *Star* in the Sign TAURUS is placed in his *left Eye*, being a *Star* of the *first Magnitude*, and is therefore called the *Bulls Eye*. Near to it are other 5 *Stars*, which are called *Hyades*: And those 6, formerly 7 *Stars*, that appear on the *Back* of the *Bull*, are called *Pleiades* and *Vergiliæ*, in the midst of which is a *Star* of the *third Magnitude*, commonly called *the Bright Star of the Pleiades*.

IX. *What Stars are in* Gemini.

There are 2 Principal *Stars* in GEMINI of the *second Magnitude*, whereof that in the *North Head* of the *Twins*, is called *Castor*; as that in the South, *Pollux*. There is also another *Star* of the same *Magnitude* in the *right Foot* of *Pollux*, towards *Orion*. There is also one of the *fourth Magnitude*, called *Propus*, because it is placed near the *left Foot* of *Castor*.

X. *What in* Cancer.

In CANCER, scarce any *Stars* appear, besides one of the *third Magnitude*, near to the *right Claw*, and 3 others of the *fourth*, 2 whereof are most noted, whereof 1 stands towards the North, the other towards the South.

XI. *What in* Leo.

The LION is adorned with divers *bright Stars*, 2 whereof are of the *first Magnitude*. That which is seen in his *Breast*, is called the *Lions Heart*, or *Regulus*; and that in his *Tail*, the *Lions Tail*. Besides these there are 2 other, the one in his *Neck*, the other in the utmost part of his *Back*; to which, if the next *Stars* in his *Loyns* be added, they, together with those of the *Heart* and the *Neck*, will represent the Figure of a long *Square*.

XII. *What in* Virgo.

In the VIRGINS *left Hand* is an *Ear of Corn*, in which there is a *Star* of the *first Magnitude*, commonly called, the *Virgins Ear of Corn*. There are also other *Stars* of the *third Magnitude*, dispers't all along the *Virgins Body*.

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XIII. *What Stars are in the* Scorpion. SCORPIUS, beſides 2 *Stars* of the *ſecond Magnitude* plac'd in the further part of his *Claws*, and 2 more of the *third Magnitude* in his *Tail*, hath another in the midſt of his *Body*, called *the Scorpion's Heart*, plac'd between 2 *Stars* of the *fourth Magnitude.*

XIV. *What in* Libra. LIBRA conſiſts of 2 very *bright Stars*, which are called *the Scales.*

XV. *What in* Sagittarius. In SAGITTARIUS are 4 *Stars* more conſiderable, which being plac'd on his *Right ſhoulder*, conſtitute a *Trapezium* or *Table*; beſides 3 or 4 that do ſomewhat reſemble a *Bow*: Beyond the midſt of which, there is another of the *third Magnitude*, which repreſents the form of an *Arrow.*

XVI. *What in* Capricorn. The *Chief Stars* in CAPRICORN are 4 of the *third Magnitude.* There are 2 in his *Tail* that have a greater luſtre than the reſt; and two other in his *Horns*, the uppermoſt whereof hath a ſmall *Star* joyned to it.

XVII. *What in* Aquarius. In AQUARIUS, the moſt conſpicuous *Stars* are ſome of the *third Magnitude* about his *ſhoulders*, with 4 others about his *right Hand*; the one whereof is, as it were, plac'd in the midſt of a *Triangle*, conſtituted by the other 3. And there is another in his *right Hand* of the *third Magnitude*; beſides which there are many other of the *fourth Magnitude*, and more eſpecially one at the end of the pouring forth of the *Water*, which is of the *firſt Magnitude.*

XVIII. *What in* Piſces. The Conſtellation PISCES conſiſts of many ſmall *Stars*; there being but few amongſt them that are as big as thoſe of the *fourth Magnitude*: And tho' theſe *Fiſhes* are at ſome diſtance from each other, the one in the Neighbourhood of *Aquarius*, under the Neck of *Pegaſus*, and the other near to the *Ram* or *Aries*, under the Breaſt of *Andromeda*; yet they are tied together with a kind of looſe *Riband*, which is alſo adorn'd with ſeveral *Stars* of the *firſt Magnitude.*

XIX. *The Northern Conſtellations, without the Zodiack* The *Conſtellations* without the *Zodiack*, are either Northern or Southern. The Northern, which appear in our *Hemiſphere*, are 21; the particular account whereof here follows, beginning with that *Conſtellation* which is next of all to the *Pole.*

1 *The* Little Bear. And this is URSA MINOR, the *Leſſer Bear*; which conſiſts of 7 *Stars*, 4 whereof repreſent a *ſquare Figure*; whereof the uppermoſt in the Neck of the *Bear*, is of the *ſecond Magnitude*; another lower than it, of the *third*; a third on the Back, of the *fourth*; and the laſt in the Back alſo, of the *fifth.* The hindermoſt and brighteſt of the other 3, is called the *Pole-Star*, becauſe it is nearer to the *Pole* of any other.

2 *The* Great Bear. URSA MAJOR, the *Greater Bear*, conſiſts likewiſe of 7 *Stars*, whereof the 4 that repreſent a *ſquare*, exhibit ſo many *Wheels*, and the other 3, the *Beam* of the *Wain*, and the *Oxen* or *Horſes* that draw it; and therefore was called by the Ancients, *Plauſtrum majus*, or the *Greater Wain.*

3 Bootes. BOOTES, the *Herdſman*, or rather the *Driver of the Oxen*, called alſo *Arctophylax*, the *Bearward*, conſiſts of many *Stars* of the *third Magnitude*, plac'd in the *ſhoulder*, *back* and *knees* of this Figure. But one of them is more famous than any of the reſt, placed between his *Thighs*, on the rim or edging of his *Coat*, being of the *firſt Magnitude*, and is called *Arcturus.*

4 *The* Dragon. The DRAGON conſiſts of many *Stars*, but none of them greater than thoſe of the *third Magnitude*; only there are 2 in the *Head* of it, that are *brighter* than the reſt.

5 *The* Crown *of* Ariadne. The CROWN of ARIADNE, plac'd at the *Right ſhoulder* of *Bootes*, repreſents a *half Circle*, compos'd of 5 *Stars*; whereof 3 are of the *fourth Magnitude*, one of the *fifth*, and another of the *ſecond*, which is called *the Bright Star of the Crown.*

6 Engonaſi. ENGONASI, the *Man*, according to ſome *Hercules*, *Kneeling*, comprizeth ſeveral *Stars* all of the ſame *Magnitude*; of which one eſpecially is more conſpicuous in the *Head* of this Figure, for its being of an equal ſize, with another *Star* like it, found in the *Head* of *Ophiuchus.*

7 Lyra, *or* the Harp. LYRA, the *Harp*, which by ſome is called *the Falling Vultur*, hath the moſt eminent *Star* of the *firſt Magnitude*, next to the *Dog-Star*; beſides which it contains ſome few other *Stars*, 2 whereof are of the *ſecond Magnitude.*

8 *The* Swan. The SWAN is an illuſtrious *Conſtellation* within the *Milky-Way*, reſembling the Form of a *Croſs*; and hath a very notable *Star* of the *ſecond Magnitude.*

9 Cepheus. CEPHEUS hath his *Head* pointing to the *Swan*, and his *right Foot* ſtanding on the *Tail* of the *Little Bear.* It contains but few bright *Stars*, beſides 3 of the *third Magnitude*, one in the *Right ſhoulder*, another in his *Girdle*, and a third in his *Right knee.*

10 Caſſiopeia CASSIOPEIA hath 5 *Stars* of the *third Magnitude*, over againſt the *Great Bear*, the leaſt being in the midſt of them; 3 of theſe are on the outſide, one of them being called *the Bright Star of the Chair*; another upon her *Breaſt*, called *Schedir*; the third near her *Flank*; all which repreſent the Figure of a *Triangle.*

11 Perſeus. PERSEUS is plac'd between the *Feet* of *Caſſiopeia* and the *Bull*, the moſt bright *Star* of which *Aſteriſm*, that on the *Back*, is of the *ſecond Magnitude.* It hath alſo another famous one of the *third Magnitude*, which being placed in the *Head* of *Meduſa* in the *Left hand* of *Perſeus*, is therefore called *the Head* of *Meduſa*, and the other 4 are call'd *Gorgons.*

12 Andromeda. ANDROMEDA is an *Aſteriſm* under *Caſſiopeia*, on the *Left-ſide* of *Perſeus*; very remarkable, becauſe of 3 *Stars* it hath of the *ſecond Magnitude*; one whereof is on the *Left Foot*, above the *Triangle*, the other in the *Girdle*, above the *Fiſhes*; the laſt in the *Head*, which is common to her and *Pegaſus.*

13 Deltoton, *or* the Triangle. DELTOTON, or the *Triangle*, conſiſts of 3 *Bright Stars* of the *fourth Magnitude*, one whereof is at the top, and the other 2 at the Baſis of it, with another *Star* of the *fifth Magnitude*, near to it.

14 Auriga. AURIGA, the *Wagoner* or *Wain-Driver*, hath a *Star* of the *ſecond Magnitude* in the *Left Foot*, where there is alſo another of the *fourth Magnitude.* But the moſt noted of them all is a *Star* of the *firſt Magnitude* very illuſtrious, on the *Left ſhoulder*, called *Capra*, the *Goat.*

15 Pegaſus. PEGASUS, or the *Flying-Horſe*, is a notable *Conſtellation*, by reaſon of a large *ſquare* compoſed by 4 of its *Stars* of the *ſecond Magnitude.* Beſides which it contains other 3 of the *third Magnitude*, the one in the *Knee*, the other in the *Neck*,

Neck, and the third in the *Opening of the Mouth*, which is therefore call'd *the Mouth of* Pegasus.

16 *The* Dolphin. The DOLPHIN, seen between the *Constellation* of the *Colt* and the *Eagle*, has 10 *Stars*, whereof 5 are of the *fifth Magnitude*: The other, except that which is in the *Tail*, do constitute the Figure of a *Lozenge*.

17 *The* Arrow. The ARROW hath 5 *Stars*, of which, that at the *Point* is of the *fourth Magnitude*.

18 *Equuleus, or* the Colt. The COLT is nothing else, but as it were the *shadow* of the *Head of Pegasus*, in which are seen 4 *Stars*, all of them of the *fourth Magnitude*.

19 *The* Eagle. The EAGLE is considerable for 3 *Stars*, representing the situation or position of *Orions Girdle*. The 2 that are at each end, are only of the *third Magnitude*; as likewise 2 others at the end of his *Tail*: The *Star* which is in the middle is of the *second Magnitude*, and out-shines the rest, being therefore call'd, *the Bright Star of the Eagle*.

20 Serpentarius. SERPENTARIUS OPHIUCHUS, or *the Serpent-Bearer*, is a great *Asterism*; for its *Head* is near to the *Head* of *Hercules*; its *Feet* rest upon the *Scorpion*; the *Head* of the *Serpent* reacheth to the *Northern Crown*, and its *Tail* to the *Eagle*. Its greatest *Star* is only of the *third Magnitude*. Yet there is one of these that is very considerable by the *right Ham*, between the *Scorpion* and *Sagittary*, which in the Fourth year of this *Century* was accounted amongst the *Great Stars*.

21 *The* Serpent *of* Ophiuchus. The SERPENT of *Ophiuchus*, is famous for several *Stars* of the *third* and *fourth Magnitude*, in the middle Joynt of the *Neck*, next to that Hand in which *Hercules* holds his *Club*.

XX. *The Southern* Constellations, *without the Zodiack.* The Southern *Signs* are 15 in Number, without the *Zodiack*.

1 *The* Whale. The first is the WHALE, situate under the *Fishes* and the *Ram*, having a vast wide Mouth, in the midst whereof is a *Star* of the *first Magnitude*, *the Bright Star of the Jaw-bone of the Whale*; and hath another of the same *Magnitude* answering to it, in the midst of the Point of his *Tail*; besides other *Stars* over his whole *Body*, of the *third* and *fourth Magnitude*.

2 *The River* Eridanus. ERIDANUS is a long and winding *Asterism* betwixt *Orion* and the *Whale*. The end of which, towards the South, is invisible to us.

3 *The* Hare. The HARE, besides other of the *Stars* whereof it is composed, hath 4 of the *first Magnitude*, and other 4 smaller ones in his *Ears*.

4 Orion. ORION is a *Constellation*, adorned with many *bright Stars*. Of these, 2 principal ones are in his *Shoulders*, 3 in his *Girdle*, which are called *Three Kings*; 1 in his *right Knee*, and another in his *left Foot*, called *Rigel*.

5 *The* Great Dog. The GREAT DOG hath not his equal for Brightness, and is commonly call'd *Sirius*, as being supposed to Dry all things. About his *right Feet* he hath some *Stars* of the *third Magnitude*.

6 *The* Little Dog. The LITTLE DOG riseth before the Greater, and is, as it were, the Harbinger of his Rising. Besides the *Star* which is in his *Neck*, of the *third Magnitude*, he hath another Bright one in his *Thigh* of the *second Magnitude*, called *Procyon*.

7 *The* Ship Argo. The *Ship* ARGO hath but a few *Stars* that are conspicuous, except it be about the *Mast*. In its *Helm* is a very noted *Star*, called *Canopus*.

8 Hydra. HYDRA, the *Hydre*, a *Water-Serpent*, is a long extended *Asterism*; for with its *Head* it toucheth the *Claws* of the *Crab*, and its *Tail* is near to *Libra*, or the *Ballance*. It hath a very *bright Star* in its *Breast* of the *first Magnitude*, called the *Heart of the Water-Snake*.

9 Crater, *the Bowl.* The BOWL, or *Cup*, is placed upon the Middle part of the *Hydra*, having some *Stars* of the *fourth Magnitude*, representing an half Round.

10 *The* Crow. The CROW is very remarkable, by reason of the Table in it, consisting of 4 *Stars*, whereof 3 are of the *third Magnitude*, and another of the *fourth*.

11 *The* Centaur. The CENTAUR, besides 14 visible *Stars*, hath others that are not conspicuous to us; whereof 1 is of the *first Magnitude*, at the *right Fore-foot* of the *Horse*. In his *hind Legs* are 4 *Stars*, which represent a very remarkable *Cross*. The Uppermost and Lowermost are of the *second Magnitude*; but the Right and Left of the *third*.

12 *The* Wolf. The WOLF, or *Wild-Beast*, doth with his *Head* reach the middle part of the *Scorpion*; it hath no *Stars* bigger than of the *fourth Magnitude*.

13 *The* Altar. The ALTAR, or *Censer*, is for the most part hid from us under the bending of the *Scorpions-Tail*. It hath no greater *Stars*, than of the *third Magnitude*.

14 *The* Southern-Crown. The SOUTH-CROWN hath one very notable amongst the rest, of the *third Magnitude*; and is the same which is called by some *Uraniscus*, or the *Petty-Heaven*.

15 *The* South-Fish. The SOUTH-FISH contains many *Stars*, and those of the *fourth Magnitude*, under the *left Leg* of *Aquarius*. In its *Mouth* it hath a Principal one of the *first Magnitude*, called *Fomahant*.

XXI. *What those Stars are that are* Unformed. Tho' the *Constellations* of the *Zodiack*, together with the North and South, are reduced to the Number of 48; yet we are to know that the *Astronomers* could not comprize them all into *Figures*, but were fain to leave some in the Intervals of them, which they called *Unformed*, as being comprehended in no *Figure* or *Image*.

XXII. *What the* Galaxy, *or* Milky-way, *is.* The *Astronomers* also make mention of the *Galaxy*, or *Milky-way*, which is nothing else but a vast multitude of thick-set *Stars*, that by their weak *Light* represent the appearance of *Milk* in a clear *Sky*, as the *Telescope* hath informed us. Whereby *ARISTOTLE* is convinc'd of a manifest Error, who suppos'd the *Milky-Way* to be a *Meteor*; who yet therein is to be pardoned, because he wanted the Helps that we have to discern it better.

XXIII. *How the* Sun, *or any* Planet, *is said to be in a Sign.* We are to observe, that when that the *Sun*, or any *Planet*, is said to be in a *Sign*: As for Example, in the *Ram*, or in the *Bull*; the meaning thereof is, that it is plac'd under it, or that it intervenes, or is intercepted between our *Eye* and that *Sign*. For it is certain, that the *Zodiack*, and its *Signs*, are at a vast distance from the *Planets*. But this way of speaking hath obtain'd, because the *Planets* appear to us, as if they were in the Region of the *fix'd Stars*. For our unassisted Sight cannot discern which of the *Stars* are farther from, or nearer to us. Hence it is, that because we know that the *Planets* are nearer to us than the *Stars*, we understand them

to

to be so placed, as to be between us and the *Signs*. But the *Stars* that are without the *Zodiack* are said to be in that *Constellation*, or rather to belong to it, between which and the next *Pole* of the *Zodiack* they are placed.

CHAP. XXVI.

Of the Influence of the Stars, and of Judicial Astrology.

I. *The sense of the Question stated.*

IT is a Question frequently handled by the graveſt *Authors*, Whether the *Stars* act upon theſe *Inferiour Bodies*; and whether the Things that happen here on *Earth* do depend on their *Influences*. Or to ſpeak more plainly, Whether the *Stars* be the *Cauſe* of thoſe *Effects* we ſee in this *Sublunary World*; or at leaſt, contribute ſomething to their *Production*. For the better underſtanding of this *Queſtion*, it will be neceſſary to examine the *Virtue* and *Power* of the *Stars*, and thence gather their manner and way of acting.

II. *The Sun influenceth this ſublunary World.*

There is no doubt, but that the *Sun* concurs by a real *influx* to the *Production* of *Terreſtrial Bodies*; yea, if we give heed to his *Virtue*, we ſhall find him to be the *only*, or at leaſt the *Principal Cauſe* of all things that are generated in the *Earth*; for the *Growing* of *Plants*, the *Nouriſhment* of *Trees*, the *Ripening* of *Fruit*, and the *Springing* of *Corn*, are all to be referr'd to the *Sun*, by whoſe *Heat* they are cheriſhed, grow, and are brought to perfection.

III. *An Objection against the Virtue of the Sun.*

If you ſay, That many things happen in the *Earth* which cannot be imputed to the *Sun*; as *Cold* and *Moiſture*, which require a Cauſe diſtinct from that of *Heat*. For how can *Heat* be conceiv'd to be the Original of *Cold*? Or, how can the *Sun*, who is of a *fiery Nature*, produce *Moiſture*, ſince the Natural effect of *Fire* is to dry, and deprive a Body of all *Moiſture*? And therefore the *Sun* can only be ſaid to be the *Cauſe* of ſome particular Effects.

IV. *Answer.*

I Anſwer, It is true that *Cold* and *Moiſture* do not proceed from the *Sun*, as their productive Cauſe; yet doth not this contradict their proceeding from the *Sun accidentally*. For as his *preſence* drives away the *Cold*, and ſuffers it not to prevail on the *Earth*; ſo his *abſence* ſuffers it to prevail, and expoſeth *Terreſtrial Bodies* to its conſtriction. In like manner, tho' *Moiſture* doth not deſcend from the *Sun*; yet becauſe the ſame abounds in the *Earth*, and that the *Sun* doth not always elevate the ſame into *Vapours*, therefore he may be ſaid to be an *Accidental Cauſe* of it.

V. *The Sun is the General Cauſe of all Effects produced in the Earth.*

The *Sun* therefore is to be conſidered by us as a *General* or *Univerſal Cauſe*, which every where diffuſeth its *Beams*; yet it happens by Accident, that he illuminates one part of the *Earth* more than another: As it is accidental to *Fire*, that this or the other thing comes near to it, to be *heated* and *cheriſhed* by it, or not. And hence it is, that all that variety, which we ſee in Nature, doth not ſo much proceed from the *Sun*, as from the various *ſituation* and *diſpoſition* of *Bodies*. For the reaſon why in one part of the *Earth* it is *Spring*, in another *Autumn*, in a third *Summer*, doth not proceed from the *Sun* as a *Special Cauſe*, but only as a *General*, the *Sun* being always the ſame, and equally diffuſing his *Heat*. For that it is now, ſuppoſe, *Summer* with us, by the *Sun-beams* falling more directly upon us; this is owing to that *Part of the Earth* wherein we live, whoſe *ſituation* is ſo directed towards the *Sun*, as to receive his *Beams* more directly, at the very ſame time that it is *Winter* with our *Antipodes*, to whom the *Suns-beams* are obliquely directed.

VI. *The Planets contribute nothing to any ſublunary Effects.*

I know that ſome *Philoſophers* refer the Cauſe of this diverſity to the *Planets*, as ſuppoſing *Saturn* to be Cold; *Mars*, Hot; *Venus*, moderately Warming; *Mercury*, Various; the *Moon*, Cold and Moiſt. But theſe I take to be no more than meer Fictions, ſince we perceive no *Cold* from *Saturn*, nor *Heat* from *Mars*; and ſo from the other *Planets*: Becauſe it cannot be, that we ſhould feel or perceive any of theſe *Qualities*, but that at the ſame time all the other *Inhabitants* of the *Earth* muſt perceive the ſame, ſeeing that they are ſenſible of theſe Viciſſitudes of *Seaſons*, as well as of the *Sun's Heat*; and therefore theſe Changes depend on the various poſition of the *Parts of the Earth*. As we ſee, that the *South-Winds*, which produce Warm Weather in the midſt of *Winter*; and *North-Winds*, which cauſe Cold in *Summer*, do not ariſe from the *Aſpects of the Planets*, ſince the ſame *Aſpects* are over the whole *Earth*, and yet we do not find the ſame *Winds* every where; ſo that they proceed only from the various diſpoſition of the *Regions of the Earth*.

VII. *The Fix'd Stars ſend down no Influences upon theſe Inferiour things.*

Neither do the *Fix'd Stars* ſeem to diſpenſe any *Influences* to us here below, becauſe their vaſt diſtance hinder them from producing any *Effects* here: For tho' by their *Light* they may put the *ſubtil Matter* contain'd in the *Pores* of the *Air* into *motion*, and by means thereof agitate other groſſer Matter, which thereby may produce a ſenſible Effect; yet becauſe we know of no other Virtue that is in them, whereby they might act upon theſe Inferiours, ſave only their *Light*, we cannot attribute to them any *Effects*, beſides thoſe that proceed from *Light*: And foraſmuch as the *Light of the Sun* is incomparably greater than that of the *Fix'd Stars*, we are to attribute all *Natural Effects* to the *Light of the Sun*, as the General and Primary Cauſe of them.

VIII. *The Fix'd Stars do not always Riſe and Set at the ſame time; and yet we find that the General Changes of Seaſons in the World keep the ſame time.*

This *Opinion* may be further confirmed, if we conſider that the *Fix'd Stars* do not Riſe and Set now at the ſame time as formerly; but becauſe of their turning round from *Eaſt* to *Weſt*, they Riſe now almoſt a whole Month later than of Old: And yet the *Seaſons* and *General Changes* that are in the *World* ſtill obſerve the ſame Tenour, and correſpond with the *Suns* Courſe through the *Zodiack*. For the *Dog-Days*, by Example, or that great *Heat*, which in old Times was perceived about the midſt of *July*, ſtill continues about the ſame term, neither is changed to the midſt of *Auguſt*, at which time the *Dog-ſtar*, which they make the Cauſe of its *Heat*, doth now Riſe. Neither can we ſuppoſe, that 6000 years hence, this *Heat* will be removed to the midſt of *November*, at which time the *Dog-ſtar* will then Riſe. Beſides, if the *Heat* we perceive in *Summer* be to be aſcribed to the *Dog-ſtar*, how comes it to paſs that at the ſame time the ſaid *Star* is almoſt 40 *Degrees* diſtant from the *Sun*? Since it might be rather expected it ſhould diſplay its *Heat* in the *Winter*, when it is conjoyn'd with the *Sun*, *viz.* about the 29*th* of *October*.

IX. *The Cause of the great Heat in Summer.* The Cause therefore of these great *Heats* is, because the *Sun* at that time sends down his *Beams* more perpendicularly upon us, and continues longer above our *Horizon*; and forasmuch as this perseveres for some Days after the *Solstice*, during which time new degrees of *Heat* are still added, it cannot be otherwise, but that the *Heat* during that time must be increased.

X. *The Moon produceth no Effects upon the Earth.* Neither doth the *Moon*, tho' she be so near unto us, produce any Effects here below. I know that several *Effects* are attributed to her by some; as the Breaking or Splitting of *Stones*, and the increasing of *Oisters*, and other *shell-Fish*, at the *Increase of the Moon*, and their decreasing at the *Wane of the Moon*; as likewise that the *Bones* of *Animals*, at the *Full-Moon*, are full of *Marrow*, whereas at the *New* they are almost empty.

XI. *What is the Cause why Stones are broken.* But all these *Effects* may be with more Truth attributed to other *Causes*, than to the *Moon*. For as to the breaking of *Stones*, the same may with more Reason be attributed to the *Sun*, than to the *Moon*; seeing it is certain, that some *Stones*, after many years lying expos'd to the *Sun*, have been calcined. And therefore seeing that the *Sun*'s *beams* reach the *Stones*, as well as those of the *Moon*, it seems very reasonable that this *Effect* should rather be imputed to the *stronger*, than the *weaker Agent*.

XII. *The increase or decrease of Oysters, doth not proceed from the increase or decrease of the Moon.* So likewise it is a Popular Error to imagin, that *Oysters* and other *shell-Fish*, are bigger and fuller at some times of the *Moon*, than at others: For tho' they are sometimes bigger than at other times, yet is not this to be ascribed to the *Moon*, but rather to *Chance*, because they have not had sufficient *Food*, or because the tossing of the *Sea* hath forced them to some Evacuations. This is apparent in those *Fishes* which are taken in the same place, and in the same day: For those which are caught in a *Net*, and immediately taken out thence, are fuller Bodied and better Fed, than those which having been long kept up, have lost much of their *flesh* by striving to get out. The original therefore of this Error hath been, for that some have taken that to be caused by the *Moon*, which was meerly fortuitous. And accordingly we find, that indifferently at any time some *Oysters* are found to be fat and full, and others lean and poor.

XIII. *The Cause why more or less Marrow is found in the Bones of Living Creatures.* And the same may be said of the *Marrow* that is found in the *Bones* of *Animals*: For several who have examin'd the matter, have found that there is no more *Marrow* in the said *Bones*, at any one precise time, than at another; but that the want or defect thereof sometimes is caused, by want of *Food*, or for that the *Beasts* have been tired by long Journeys before they were kill'd.

XIV. *What Judicial Astrology is, and of how many sorts.* *Astrology is an Art, which foretells future things from the motion of the Heavenly Bodies, and their Aspects to one another.* And is therefore called *Judicial*, because from these it judgeth of the *Events* of things. *Astrology* is twofold; the one is that *Art*, which from the position of the *Stars* at the time of *Birth*, judgeth of the *Inclinations* and *Tempers* of Men, whether they will be *Passionate*, *Melancholy*, *Wise*, *Venereal*, *&c.* because the Hour of their *Nativity* was accompanied with such or such *Aspects of the Stars*, which have a Virtue of causing the *Gall*, *Melancholy*, or *Spirits* to abound. The second kind of *Judicial Astrology* is that *Art*, which from observing of the *Horoscope*, judges of *Future Events*, *Children*, *Manner of Life*, *Marriage*, *Honours*, *Misfortunes*, *Losses*, *&c.*

XV. *Who were the first Professors of it.* This *Judicial Astrology* was first cultivated by the *Chaldæan* and *Babylonian Philosophers*, who not only affirmed that they could Foretel *Future Events* from the *Aspects* of the *Stars*; but also boasted that by them they could discover the particular *Actions of Men*, and the *special Events* of their *Lives*. But that both the one and the other of these are vain and false we prove as follows:

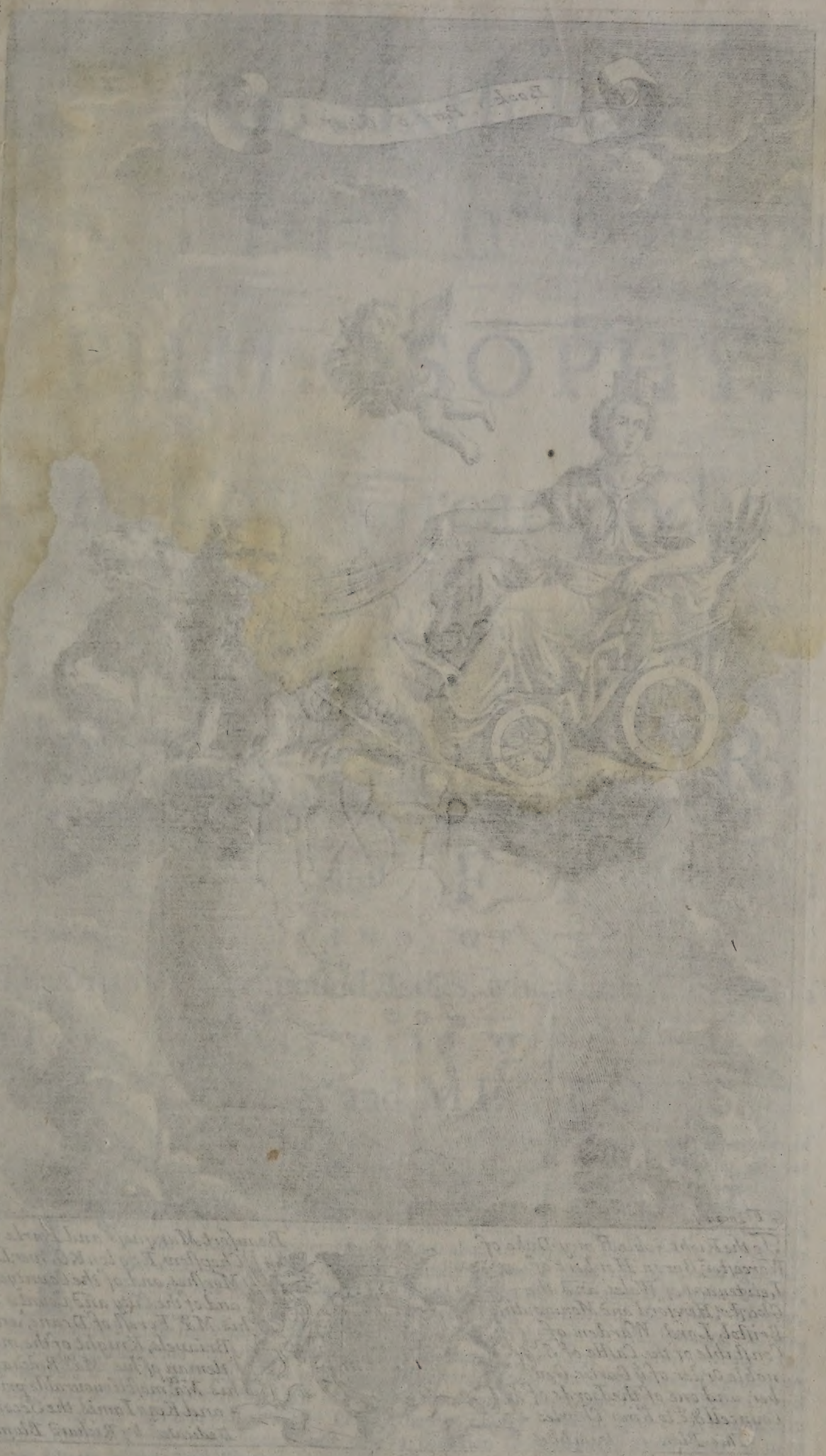
XVI. *Reasons against Judicial Astrology.* *First*, Because the *Astrologers* had no exact knowledge of the *Virtues* of the *Stars*, no not of such as were most Notorious. *Secondly*, Because they were ignorant of the Nature of most *Stars*, which might variously alter or hinder the operations of those *Stars* they knew. *Thirdly*, Because no sufficient Reason can be given, why *Schemes* for *Nativities* are erected from the point of *Birth*, rather than from that of *Conception*. *Fourthly*, Because the *Astrologers* themselves own, that they have no *Principles* whereby they might be informed, that the *Stars* have such *Virtues* as they assign to them, and that consequently their *Predictions* are not any deductions from *Premisses*, but the Dreams of Idle men.

XVII. *Astrologers can have no certain Experience.* Besides, how can they be assur'd of the certainty of the *Events* they pretend to guess at? Not by *Experience*: For who will conclude that it will lighten, for Example, upon the *Kings* entring into St. *James*'s *Park*, because once it hapned so? Or that some *King* will dye at the Appearance of a *Comet*; because it hath been found, that upon the Appearing of a *Comet* some *Prince* hath died? And much the same Evidence the *Astrologers* have for their *Predictions*, since it is but once in many thousand years, that the *Stars* are found in the same position.

XVIII. *What happens to one part of the World, cannot be brought as an Argument to prove that the same will happen in another part.* But let us grant the *Astrologers*, that some Changes have been observ'd to come to pass in certain places of the *Earth*, under such *Constellations*; yet can these only be of use to those *Countries* where they hapned: Seeing it is most certain, that the same *Fair weather*, or *Tempests*, do not happen to all parts of the *Earth* at the same time: For we see it *Rain* in one part, whilst it is *Fair weather* in another. And thus the *Dog-star*, which most suppose to be *Hot* by Nature, and to be the Cause of the greatest *Heat* when it Riseth in *July*, is notwithstanding a sign of *Cold* to our *Antipodes*, and to those that live in the South-part of the *Earth*; because they at the same time that this *Constellation* Riseth, together with the *Sun*, and we feel the greatest *Heat*, experience the greatest *Cold*: Notwithstanding that it is then directly over their *Heads*, and sends down its direct Rays upon their *Country*.

XIX. *The Conclusion.* Conclude we therefore, according as we have said at the Beginning, that the *Sun* is the General Cause of all the *Effects* that happen in this *Sublunary World*, forasmuch as by his presence he is the Cause of *Heat*, and by his absence of *Cold*; and that all the rest of the *Stars* or *Planets*, cannot be the Cause of any Alterations in these *Sublunary things*.

The



XV. Who were the first Professors of it.

XVI. Reasons against Judicial Astrology.

XVII. Astrologers can hardly maintain Experience.

XVIII. What happens to one part of the World cannot be brought as an Argument to prove that the same will happen in another part.

XIX. The Conclusion.

To the Right Noble Henry Duke of Beaufort Marques and Earle of Worceſter, Baron Herbert of Chepſtow, Raglon & Gower, Lord Leivtentant of Wales and the Marſhes, and of the Countyes of Gloceſter, Hereford and Monmouth, and of the Citty and County of Briſtol, Lord Warden of his Ma.tys Foreſt of Deane, and Conſtable of the Caſtle of S.t Briavels, Knight of the moſt noble Order of ye Garter, Gentleman of his Ma.tys Bedchamber, and one of the Lords of his Ma.tys moſt Honourable privy Councell & c. to King Charles and King Iames the Second.

This Plate is humbly Dedicated by Richard Blome.

The Sixth Part
OF THE
INSTITUTION
OF
PHILOSOPHY.
OF
The Four Great Bodies,
Viz. THE
EARTH,
THE
WATER,
THE
AIR, and FIRE;
AND OF
The Mixt and Compound Bodies, which arise from them;
AS ALSO OF
METALS, and METEORS.

CHAP. I.
Concerning the Original of the Earth, its Parts and Figure.

I. *What the Earth is.*

THE EARTH *is a congested Mass of the greater Particles of the Third Element, having Irregular Figures, and by Rest clinging together.*

II. *The Formation of the Habitable Earth.*

But, forasmuch as by the Name of EARTH, we commonly understand the whole *Globe* which we *Inhabit*, it will be a fit place here to speak of its *Original*, and to describe how at first it might have been form'd, had it so pleas'd GOD: Let us imagine therefore, that it was made at first only of the *Matter* of the *First Element*, being like unto the *Sun*, tho' much less than it; and that it had a vast and peculiar *Vortex* in the *Center* whereof it was seated. But that by the clinging together of the less *Subtil Parts* of the *First Element*, they were changed into the *Matter* of the *Third Element*, which gathering together produced *dark Spots* about its *Surface*, like to those that are continually generated about the *Sun*, and again dissolved. Upon the continual Dissolution whereof, the remaining *Particles* of the *Third Element*, being scatter'd through the Neighbouring *Heaven*, made there a vast *Mass* of *Æther*, which being afterwards greatly increased, caused the *generation* of more *compact Spots*, which at last wholly cover'd the whole *Earth*. Which *Spots* being no longer in a condition to be dissolved, and many of them lying heaped together, and the Force of the *Vortex*, which contain'd the *Earth* being thereby diminish'd,

gave

gave occaſion to the *Sun*'s *Vortex* to ſwallow up the *Earth*, together with the *Spots*, *Air*, and all, which ſtop'd in that place where it now is.

III. *There are three Regions to be diſtinguiſht in the Earth.* Suppoſing the *Earth* in this *ſtate*, we are to take notice of Three *Regions* in it: Whereof the *Firſt* and Inmoſt I ſeems to contain nothing but the *Matter* of the *Firſt Element*, which is there moved like the *Sun*, and much of the ſame Nature; ſave only, that probably it is not ſo pure, becauſe it cannot rid it ſelf of that *Matter*, which the *Sun* continually caſts forth, and of which *Spots* are generated. The *Middle Region* M, conſiſts of a very dark and compact *Body*: For ſeeing that this *Body* was at firſt made up of very minute *Particles* (as at firſt appertaining to the firſt *Element*) joyn'd together, it ſeems probable that there could be no *Pores* in it, but ſuch only as were ſo ſmall, that they could only tranſmit thoſe *ſtriate Particles* with the other *Matter* of the *Firſt Element*. And Experience witneſſeth as much in the *Spots* of the *Sun*, which being of the ſame nature as this *Body* M; ſave only that they are much more thin and looſe, do notwithſtanding obſtruct the paſſage of *Light*, which could not be in caſe their *Pores* were large enough to admit the *Globuli* of the *Second Element*. For ſeeing that theſe *Pores* were at firſt formed in fluid and ſoft *Matter*, they would alſo without doubt be ſtrait and ſmooth enough, not to hinder the Action of *Light*. But theſe two *Regions* of the *Earth* do not much concern us, as being conceal'd from us. The *Third Region*, is that out of which all *Earthly Bodies* are formed, as we ſhall ſhew hereafter: At preſent we ſuppoſe nothing to be in it, beſides a *vaſt Maſs* or gathering together of the *Particles* of the *Third Element*, encompaſs'd with much *Heavenly matter*, whoſe nature we may eaſily underſtand from the manner of their *Primordial Generation*.

Figure 35.

IV. *The Formation of the various Earthly Bodies.* From what hath been ſaid, we eaſily apprehend, that no great Change could happen in the innermoſt or middle *Region* of the *Earth*; but the *External part* of it, was capable of being formed into various *Bodies*. For at the firſt 2, then 3, and afterwards 4, with many other different *Bodies*, were to be made out of it.

V. *The Uppermoſt Region of the Earth diſtinguiſht into two Bodies.* And here, in the firſt place let us conſider, that the groſſer *Particles* of this *Third Region* being thruſt down below the reſt, by the force of the *Heavenly Globuli*, this Supream part of the *Earth*, here marked with the Letter A, is thereby diſtinguiſh'd into two different *Bodies*, repreſented by B and C; whereof the uppermoſt B, is of a *looſe* contexture, *fluid* and *pellucid*; whereas the undermoſt is ſomewhat *cloſe*, *hard* and *opake*.

Fig. 36.

VI. *The Formation of the Third Body, between the two former.* Again, becauſe we find that the *Body* C was diſtinguiſh'd from the *Body* B, only by this means; becauſe its Parts being preſt downwards by the *Heavenly Globuli*, did cling together, we ſhall eaſily apprehend, that it was neceſſary that another *Body*, ſuch as is that marked D, muſt have been generated between them. For the *Figures* of the *Particles* of the *Third Element*, of which the *Bodies* B and C conſiſt, are very *different*, and may be here diſtinguiſh'd by us into 3 Chief General *Heads*; for ſome of them are variouſly divided and extended like the *Branches* of *Trees*, and theſe chiefly were thoſe, which being driven down by the *Celeſtial matter* cling together, and compoſe the *Body* C. Again, there are others that are *more ſolid*, and as to their *Figure*, are not all of them *Round* or *Cubical*, but of ſeveral *Figures*, like the ſmall parts of *Rubbiſh*; and theſe, if they be ſomewhat great, ſink down below the reſt by the force of Gravity; but in caſe they be ſomewhat leſs, they continue mix'd with the former, and fill up the Spaces that are left by them. Laſtly, there are ſome of a *longiſh Figure*, and without any Jettings-out like *Boughs*, but like long and even *Sticks*, which alſo mingle themſelves with the former, where they find *Pores* or *Intervals* wide enough for them to enter, but do not readily cling or ſtick to them. Which being thus ſuppoſed, it will be obvious to believe, that when firſt the *Branchy Particles* of the *Body* C began to be entangled together, many of the *Longiſh* were intermix'd with them; and that they afterwards, whilſt thoſe being ſtill more and more preſt down, became more cloſely joyn'd together, got up above them towards D, and there conſtituted a *Body*, very different from the two other B and C. After the ſame manner as we ſee, that by Treading the *Earth*, in *Mooriſh places*, *Water* is ſqueez'd out of it, which afterwards comes to cover the *Surface* of it.

VII. *The Formation of the Fourth Body.* Now when ſome other *Particles* leſs ſolid than thoſe of the *Body* D, fell down from B, they ſtuck to the *ſurface* of the *Body* D; and becauſe moſt of them were *Branchy*, they by degrees clung together, and conſtituted the *hard* *Body* E, very different from B and D, which are *fluid*. Which *Body* E, at the firſt was very thin, like a *Cruſt* or *Shell* covering the *Body* D; but grew thicker in proceſs of time, new *Particles* from the *Body* B, as likewiſe from D, joyning themſelves to them.

VIII. *How a Space was left between the Third and Fourth Body.* We are likewiſe to conſider, that it could ſo happen in proceſs of Time, that a great part of the *Body* D, might be waſted, by which means a conſiderable Space F, might be left between D and E, which could not be fill'd up with any other *matter*, beſides that out of which the *Body* B did conſiſt, the thinneſt *Particles* whereof, eaſily found a paſſage through the *Pores* of the *Body* E, into thoſe places which were quitted by other thicker *parts*, which came forth from D.

Figure 37.

IX. *How Cracks or Slits came to be in the Fourth Body. And how it broke into ſeveral pieces.* Laſtly, We may grant, that many Cracks might be made in the *Body* E, by the *heat* of the *Sun*; as we find that there are many *Cracks* in the *Ground* in *Summer time*, when it is parched by the *Sun*; and that theſe *Cracks* grow greater and greater, the longer that the *Drought* laſts: By which means its *parts* at laſt did ſo looſly hang together, that it was no longer able to hold up as an *Arch* between F, and B; but being broke to pieces, by reaſon of its *Heavineſs* fell down upon the *Surface* of the *Body* C; and foraſmuch as that *Surface* was not *broad* enough, for to receive all the *Fragments* lying together, ſo as to keep the ſame ſituation they had before, ſome of the ſaid *Fragments* were forced to lye ſhelving one upon another. As for Example, If we ſuppoſe that in that part of the *Body* E, which this *Figure* repreſents, the chief *Crack* or *Slits* were ſo diſpoſed in the places 1, 2, 3, 4, 5, 6, 7. that the two *Fragments* 2, 3, and 6, 7, ſhould fall a little before the reſt, and the ends of the four other *Fragments* 2, 3, 5, and 6, before the oppoſite 1, 4, and V; as alſo the End 5, of the *Fragment* 4 5, before the End V of the *Fragment* V, 6, there is no queſtion but

Figure 38.

but they would be rang'd upon the *Surface* of the *Body* C, in the ſame manner as they are delineated, *viz.* ſo as that the *Fragments* 2, 3, and 6, 7, would be joyned next to the *Body* C, and the other four lye ſhelving on their ſides, the one leaning upon the other,&c. Figure 38.

X. *That hence was the Original of Mountains, Plains, Seas,&c.*

Further, if we conſider that by the *Body* B, and F, here, the *Air* is to be underſtood; and by C, an inward very thick Cruſt of the *Earth*, from whence *Metals* are generated; by D, the *Water*; and laſtly by E, the outward part of the *Earth*, which conſiſts of *Stones*, *Clay*, *Sand* and *Mud*; we ſhall eaſily underſtand by the *Water* ariſing above the *Fragments* 2 3, and 6 7, the *Sea*; by other *Fragments* that are but a little leaning, and not cover'd with any *Waters*, as 8, 9, and V X, great *Plains*; and by others that ſtand more upright, as 1 2, and 9 4 V, *Mountains*. We ſhall alſo take notice, that when theſe *Fragments* by their own weight thus fell down, their extremities or ends forceably daſh'd againſt each other, which made them fly into many leſs *Fragments*; which made *great Stones* on ſome *Sea-ſhoars*, as at 1; and ſeveral *tops* of *Mountains*, partly very High, as at 4; partly Riſing only, as at 9 and V; as alſo *Rocks* in the *Sea*, as at 3 and 6.

XI. *The Earth is a Round Body.*

As to what belongs to the *Figure* of the *Earth*, it may be *Mathematically* demonſtrated that it is *Spherical*; but foraſmuch as *Mathematical Demonſtrations* ſeem obſcure to thoſe who are ignorant in the *Doctrin* of *Dimenſions*, it will here be ſufficient to prove it to be ſo: *Firſt*, Becauſe its *Particles* are equally preſt on all ſides by the *Heavenly Matter* that ſurrounds it. *Secondly*, Becauſe the *Sun*, who is at a great height above us, doth not *enlighten* all the *Parts* of the *World* at once, but firſt vouchſafes his *Light* to the *Eaſtern Inhabitants*, and afterwards to the *Weſtern*; in which communication of his *Light* he obſerves this proportion, that thoſe who live 15 *Degrees* nearer to the *Eaſt*, perceive his *Light* one *hour* ſooner; and thoſe who live 30 *Degrees* nearer, two *hours*, and ſo for the reſt, obſerving the Proportion of 15 *Degrees* for each *hour*. Which could not be ſo, if the *Earth* were not of a *Round figure*.

XII. *The ſame proved from the poſition of the Stars.*

The ſituation of the *Stars* alſo confirms this. For thoſe *Stars* which are about the *North Pole* are always in ſight; whereas thoſe that are about the *South Pole* do not appear, except we move ſo far towards the *South*, as to be in the midſt between both *Poles*: In like manner the *Sun* doth ſooner Riſe and Set to thoſe that live more *Eaſtward*, than to thoſe that live *Weſtward*, as appears by an *Eclipſe*, which was ſeen by us at *Midnight*; and by thoſe that liv'd *Eaſtward*, not till after 3 a *Clock*.

XIII. *The Mountains are no Argument againſt the Round Figure of the Earth.*

Neither is the Inequality of the *Surface* of the *Earth*, by reaſon of *High Mountains* and *Deep Valleys*, any Proof againſt its *Roundneſs*: For the *Earth* is not *Mathematically Round*, as an exact poliſh'd *Globe*, but *Geometrically*; inaſmuch as all theſe Inequalities, compar'd with the *Compaſs* of the *Earth*, are no more an obſtacle to its *Roundneſs*, than the unevenneſs of the *Rind* of an *Orange* ſpoils the Roundneſs of its *figure*.

XIV. *What we are to underſtand by the Globe of the Earth.*

By the *Globe* of the *Earth*, we do not only underſtand the *Earth* it ſelf, but the *Water* alſo which covers a great part of it; ſeeing that the Parts of both of them tend to the ſame common *Center*; and becauſe the *Surface* of the *Sea* is continuous with that of the *Earth*; ſo that to thoſe who Sail *North* or *South*, or Inhabit *Eaſtward* or *Weſtward*, the ſame Quarters of *Heaven* appear, or diſappear. Which is an evident Proof, that the *Surface* of the *Earth* is not a *level* or *plain*, ſince thoſe that ſet *Sail* do find, that the ſwelling Roundneſs of the *Sea* hides the *Earth* from them, and at laſt makes it altogether diſappear.

XV. *There can be no exact Parallels upon the ſurface of the Earth.*

Accordingly GASSENDUS well infers, that no two *Plumb Lines*, or *Perpendiculars*, are exactly *Parallel*; and conſequently, that no two *Walls* built by a *Plumb-Line*, are ſuch; tho' they appear ſo to the *Eye*: For ſeeing that all *Perpendiculars* fall upon the *Convex ſurface* of the *Earth*, they muſt needs meet in the *Center*, in caſe we ſhould ſuppoſe them to be drawn on at length, and conſequently cannot be *parallel*.

XVI. *The Bigneſs of the Earth.*

Foraſmuch as the *Semidiameter* of the *Earth* is a *Meaſure*, whereby we diſcover the *magnitude* and *diſtance* of the *Stars*; we are to take notice that one *Degree* of a great *Circle* doth contain 60 *Miles* on the *ſurface* of the *Earth*: By which Number, if we multiply the 360 *Degrees* that are in a whole *Circle*, we ſhall find that the Compaſs of the *Earth* conſiſts of 21600 *Miles*. Beſides, we are to obſerve, that when a *Circle* is divided into 22 *parts*, its *Diameter* contains 7 of them, and its *Semidiameter* 3 and an half: So that the whole Compaſs hath the ſame proportion to the *Diameter*, as 22 to 7. Wherefore the *Diameter of the Earth* conſiſts of 7200 *Miles*, and the *Semidiameter* 3600 *Miles*.

XVII. *Other Properties of the Earth.*

From the Deſcription we have already given of the *Earth*, it follows alſo that it muſt be *Hard* and *Dry*: For the *Dryneſs* and *Hardneſs* of any *Body* proceeds from the Reſting of its *Parts*. As alſo, that it muſt be *Cold*: For ſeeing that its *Parts* have either but a very weak, or elſe no *motion* at all, neither can they be conceived to have any *heat* to ſpeak of. It is neceſſary alſo that it ſhould be *Heavy*: For ſeeing its *parts* have leſs Force than others, to recede from the *Center* of the *Vortex* wherein it is contain'd, they muſt needs be driven down towards it. So likewiſe it is *Opake*, and reflects the *Light* it receives; by reaſon of the Interruption and manifold Windings of its *Pores*, not exactly anſwering to one another.

XVIII. *There are four kind of Pores in the inward parts of the Earth.*

There are 4 kind of *Pores*, that are found within the *Earth*. The *Firſt* whereof are ſuch as are extended in length, but with wavings and turnings this way and that way. The *ſecond* are ſtrait *Pores*, whereof ſome have a hollow *Surface*, but rough and rugged, and others ſmooth and even. The *third* kind are thoſe, that run into one another, and whereof one has often communication with many other *Pores*, upon which account we may compare them to the *Branches* of *Trees*. And laſtly, the *fourth* kind of *Pores* are ſuch, as are ſomewhat like *Screws*.

XIX. *All the Pores that are of the ſame kind, are not altogether alike.*

But tho' we have here deduced all the *Pores* of the *Earth* to *four* kinds; yet we allow that there may be infinite variety in one and the ſame kind, ſo that it may be there are not two *Pores* of one and the ſame kind, that are altogether like one another.

CHAP. II.

The Earth is moved by the fluid Heaven, that encompaſſeth it round.

I. *The Common People ſuppoſe the Earth to remain immoveable in the midſt of the World.*

THe *Common People* are not more obſtinate in any Perſuaſion, than they are in that of the *Earths Immobility*; for they cannot imagine, that that which is the foundation and ſupport of all things, ſhould be moved; or that a *Body* of ſuch prodigious Weight and Bulk ſhould be carried about by another. Hence it is they believe, that the *Sun* and *fix'd Stars* are whirl'd round about us, and that the *Earth* reſts immovable in the midſt of the *Heaven*. Indeed our *Eyes* are not wanting to confirm this Perſuaſion; for we ſee that the *Stars* turn towards us from the *Eaſt* to the *Weſt*, and that the *Sun* after the ſame manner inſenſibly approacheth to us.

II. *We muſt not be too apt to truſt our Senſes.*

But we ought to remember, that we muſt not too much rely upon the report of our *Senſes*. For in this caſe it is with us, as with thoſe that are in a *Ship*, who think that the *Shoar* departs from them, when indeed they themſelves do depart from the *Shoar*. For to make a thing appear as if it were moved, it is all one, as *ARISTOTLE* ſaith, *Whether the Motion be in the Spectator, or in the thing that is moved.* Wherefore neither muſt it ſeem ſtrange to us, who are carried about with the *Earth*, from whence we ſee nothing but the Roof of *Heaven*, and the *Stars* in a manner reſting in their ſeveral *Stations*, that they do ſeem to draw near, paſs by, and depart from us, the *motion* of the *Earth* being moſt ſteady and even. This is the *Reaſon*, that whilſt Men look upon the *Earth*, they cannot conceive it to be moved; but when they turn their *Eyes* to any other *Object*, with regard to which the *Interval* is either increaſed or diminiſhed, then indeed it ſeems to be moved: But our *Sight*, or rather our *Mind*, is more apt to aſcribe it to the thing *ſeen*, tho' it be at reſt, than to the *thing* that is *moved*, which it finds to be at no diſtance from it ſelf. But that we may not ſeem to aſſert this without any grounds, we will enquire, Whether the *Earth* in it ſelf have any *Repugnance to motion*; and if we find it hath not, Why ſhould not we conclude that it is *moved?*

III. *The Objections that are made againſt the Motion of the Earth.*

Two things are only alledg'd againſt *the Motion of the Earth, viz.* its *Bulk*, and its *Weight*. For they Object, that all the *parts* of the *Earth* tend to the *Center*, where they are kept by the force of their *Gravity*. As we ſee that *Stones* and *Metals* reſt in their ſeveral *places*, whence they cannot be removed without *force*, by reaſon of the propenſion they have to the *Center*. But that this Reaſon is not concluſive, appears from hence, that round *Bowls* or *Bullets*, made of *Iron* or *Steel*, are by a ſmall Force made to trundle along a Plain or Level. *Stones* therefore and *Metals* continue in their *places*, not becauſe they ſtrive to tend towards the *Center*, but becauſe they are firmly joyned to the *Bodies* whereon they lye; which Impediment is not to be found in the *Earth*, as being ſurrounded with the *Fluid Heaven.*

IV. *There is no inward*

Beſides, we know that there is no *Inward Gravity* in the *Earth*, ſeeing that all *Gravitation* is cauſed by the *Heavenly Globuli*, which drive *Terreſtrial Bodies* towards the *Center*; ſo that if we ſhould ſuppoſe all the Space about the *Earth* to be fill'd with ſuch *Bodies*, as did neither promote nor hinder the *motion* of other *Bodies*, and the *Earth* to be turn'd about its *Axis* in 24 *Hours*, all its *Parts*, which did not very cloſely ſtick together, would fly away on every ſide; as we find that *Sand*, which is caſt into a *Whirlpool*, is every way diſſipated. And accordingly we may rather account the Parts of the *Earth* to be Light, than Heavy. *Heavineſs in the Earth.*

V. *The Heavineſs of the Earth cannot hinder its Motion.*

Neither do I ſee what elſe can be underſtood by the *Heavineſs* of the *Earth*, than a Quality whereby *Bodies* tending towards the *Center* of the *Earth*, have a tendency alſo to lye cloſer and cling together. Now ſuch a *Heavineſs* cannot hinder the *Earth* from being whirl'd about with the *motion* of the *Heaven* that ſurrounds it; no more than a Company of *Men*, being in a *Boat* that is whirl'd round, could hinder their turning round, by their mutual embracing and holding faſt to one another.

VI. *Its Bulk is no obſtacle to its Motion.*

Neither can the Bulk or Magnitude of the *Earth* hinder its *motion*: For the *Bigneſs* of a *Body* doth not deprive it of *Mobility*, which is a Property of all *Bodies*, and cannot be removed from them, except we ſhould own all *motion* to be violent.

VII. *The Earth is turn'd round by a yearly and daily Revolution.*

We muſt conclude therefore, that the *Earth* can be carried round by the *Cæleſtial matter* that ſurrounds it. For ſeeing that according to our *Suppoſition*, the *Vortex* of the *Earth* hath been ſwallow'd up by that of the *Sun*; and that by this means the *Earth* hath been thruſt down to that place where it now is, where it is ſurrounded with the *Fluid Heavenly matter*, always turning round, it cannot be otherwiſe but that the *Earth* muſt be carried about with it. This is clear of it ſelf. *Secondly*, from the *Nature* of the *Earth*, which being a *Planet*, muſt not only be carried round by an *Annual motion*, in the ſurrounding *Cæleſtial matter*; but alſo by a daily *Circumvolution*: For the *Earth* having formerly been a *Star*, may eaſily be conceived to have retain'd the *motion* it had before; and ſeeing that the *ſubtil Matter* in its *Center* doth turn round, it communicates that *motion* to the other Parts of the *Earth*, and makes the whole to turn round likewiſe.

VIII. *An Objection againſt the Earths being a Planet.*

But youl'l ſay, What reſemblance is there between the *Earth* and the *Planets*, ſeeing that it is the meaneſt of all other *Bodies?*

IX. *The Properties of a Planet do belong to the Earth.*

Yet for all this, if we conſider the *Form* and *Nature* of the *Earth*, we ſhall meet with ſeveral *Arguments* to perſuade us, that it is a *Planet*. For it is very like to the *Planets* in its *bulk* and *bigneſs*. Its *figure* alſo and *ſituation* prove the ſame; for it is as round as they are, and hangs pois'd in the midſt of the *Air*. So alſo like them, it wants *Light* of its own, and ſhines only with a borrowed Refulgency from the *Sun*: And laſtly, It is ſubject to the ſame *Appearances, Aſpects, Directions, Stations, Retrogradations, &c.* For to paſs by its various Reciprocations with the *Moon*, whatſoever *Mercury* and *Venus* do appear to the *Earth*, the ſame doth the *Earth* appear to *Mars*, *Jupiter*, and *Saturn*: And as *Mars*, *Jupiter*, and *Saturn* appear to her, ſo doth ſhe appear to *Venus* and *Mercury*. Wherefore ſince the *Planets* are moved, why may not we conclude that the *Earth*, foraſmuch as it

is like them, must likewise move about its own *Axis*, and about the *Center* of the *Universe*. How does it appear then, that the *Earth* is the meanest and most ignoble of all *Bodies*; but only from that mistaken Opinion, that the *Matter* of *Heaven* is something that is *Divine*, and that the *Earth* is nothing else but the very Sink of the *World*? What can hinder the *Earth* from being as Noble a *Body* as *Venus*, *Mercury*, or any other *Planet*?

X. *According to* Tycho's *Hypothesis, the Earth is moved most of all.*

This Opinion will not seem strange to those that follow *TYCHO BRAHE*; for upon examining of his *Hypothesis* they will find, that he attributes more *Motion* to the *Earth* than we do. For supposing the *Earth* to be immovable, the *Heaven* and *Stars* must whirl round it in 24 *hours*; but this cannot be done, except that the Parts of the *Earth* be translated out of the Neighbourhood of those Parts of the *Heaven* which they touch; and forasmuch as *Motion* is nothing else than such a *Translation*, we may well conclude, that according to his *Hypothesis*, a *motion* must be attributed to the *Earth*. Yea, if we consider rightly of the Matter, we must conclude that the *Earth* is more moved than the *Heaven* it self; forasmuch as the *Earth*, according to its whole *Surface*, doth recede from the *Body* that surrounds it; whereas the *Heaven* only removes according to its hollow *Surface*, which is very little if compar'd with its *Convex Surface*. And thus according to *TYCHO*'s *Hypothesis*, there is an evident Reason for attributing a *motion* to the *Earth*; whereas the Reason whereby he attributes *Motion* to the *Heaven*, and *Rest* to the *Earth*, is altogether uncertain, and forged by his own Imagination.

XI. *The Motion of the Earth produceth no diversity of Aspect in the fix'd Stars, because of their vast distance.*

You'l say, If the *Sun* has its position amongst the *fix'd Stars*, and the *Earth* be moved round it, it is necessary that the *Earth* must at some times be nearer to them, by the whole Space of its *Orb*, than at other times; but the *Appearances* make out no such thing to us.

To which I Answer, That this Difficulty will vanish, if we consider the vast Distance that is between us and the *fix'd Stars*, which is so very great, that the whole *Orb*, which is describ'd by the *Earth* about the *Sun*, is but a *Point* compared with it. Which tho' it may seem to be incredible to those, who are not used to consider the *wonderful Works* of *GOD*, and who look upon the *Earth* as the chiefest part of the *World*, and the *Habitation* of *Man*, for whose sake all other things were made: Yet can it not seem so to *Astronomers*, who are well acquainted with these things.

XII. *The Globe of the Earth is of an imperceptible Magnitude, when compared with the vast Compass of the Starry Heaven.*

From hence also we may easily answer the Objection of some *Astronomers*, alledging, That if the *Earth* were not in the midst of the *World*, the whole *Hemisphere* could not appear to us, or the one half of the *Heaven*, and especially of the *Zodiack*, which always contains 6 *Signs*. For these Men do not consider, that the whole *Earth*, compar'd to the *Heaven*, is of an *insensible Bulk*. Which thing *PYTHAGORAS* and *COPERNICUS* do not only affirm concerning the *Earth*, but also of the *Annual Orb*, compar'd with the *Heaven* of the *fix'd Stars*: For they assert, That 2 *Plains*, whereof the one being drawn through the *Sun*, the other through the *Surface* of the *Orb*, as *Horizontal*, would appear to meet together, because of the vast *Distance*: So that by that time they reach the *Heaven*, notwithstanding that they are terminated at *Circles* so greatly distant from each other, as is the *Sun* from the *Earth*, they will seem to end at the same indivisible *Point*; neither doth the amplitude of the great *Orb*, hinder us from seeing the whole *Hemisphere*, and whole 6 *Signs* of the *Zodiack*.

In the *second* place you'l Object, That it hath been asserted in the *General Physicks*, that a *Body* which is turn'd round, doth endeavour, as much as in it lies, to recede it from the *Center*: How then comes it to pass, that *Castles* and *Steeples* are not cast off into the *Air* by this Circular motion of the *Earth*?

XIII. *How it comes to pass, that this Motion of the Earth, doth not overturn Houses and Buildings.*

It is Answered, That all the Parts of the *Earth* are on all sides prest down towards the *Center*, and hindred from flying loose and being scatter'd abroad: For the *Heavenly Globuli* moving by right *Lines*, or such as little deviate from them, drive with great force against the *Earth*; and thus thrusting all its Parts towards the *Center*, hinder it from flying out towards the *Heaven*: For seeing that the *Heaven*, which lies between the *Earth* and the *Moon*, is much more swiftly carried about the *Earth*, than the *Earth* is carried about its *Axis*: And since the *Particles* whereof the *Heaven* consists, are most fluid and variously agitated in *Right Lines*, or approaching thereto, they with great force strike against the *Earth*, by which means all the *parts* of the *Earth* are compress and thrust towards the *Center*.

XIV. *The Answer.*

CHAP. III.

The Earths Motion established by other Arguments.

FOrasmuch as it is evident from what hath been said already, that the *Earth* of it self hath no repugnance to *Motion*; and that neither its *Bulk*, or *Heaviness*, can hinder it from being carried about by the *fluid Heaven*: It remains now that we superadd some *Reasons*, which have not only induced our Modern *Mathematicians*, but also the *Ancients*, to favour this Opinion.

I. *The Earth hath no Repugnance to Motion.*

But before I enter upon these *Arguments*, I would desire such as are free from Prejudice, to contemplate the vast extension of the *Heavens*, and compare the same with the small *Bulk* of the the *Earth*, which is so many Thousand times less: (For even the Common Opinion admits the *Circumference* of the *Firmament* to exceed that of the *Earth* 50000 times.) Next, let them consider the *swiftness* of that *Motion*, which we must necessarily allow to those high *Bodies*, if we suppose them to be whirl'd about the *Earth* in the space of 24 *Hours*. Which being attentively consider'd, I question not but they will be more inclin'd to think the *Heavens* immovable, and that the *Earth* by its *Diurnal motion* is turn'd round the *Sun*, than that the whole *Universe* is snatch'd round about it, with a *swiftness* that is altogether unconceivable.

II. *The vast Extension of the Heaven, and the Littleness of the Earth, are to be well consider'd.*

For the *Mathematicians* do allow, that the *fix'd Stars* are distant from us 14000 *Semidiameters* of the *Earth*. And since, according to *ARCHIMEDES* his Computation, the *Semidiameter* of the *Earth* consists of 859 *German Miles*, every one of which contains 4000 *Geometrical Paces*, or 20000 *Foot*, the *Circumference* of the *Sphere* of

III. *The Motion of the Stars is incredible.*

of the *fix'd Stars* will be of 75592984 *German Miles*. And seeing all this Space must be run over in 24 *hours*, in 1 *hour* the 24*th* part of it must be dispatch'd, that is, 3149066 *German Miles*; in the 60*th* part of an *hour*, or a *first Minute*, 52494 *German Miles*; in a *second minute*, that is, the 3600*th* part of an *hour*, 874 *German Miles*, that is, 3496 *Italian Miles*, or 3496000 *Geometrical Paces*, or 174900000 *Foot*, which is inconceivable in so short a Space.

IV. *The Earths Motion, proved by an Argument drawn from the* Ptolomaick *Hypothesis.*

A strong Argument for the *Earths Motion*, may likewise be drawn from the *PTOLOMAICK Hypothesis*. For according to it, the *Heavenly Bodies* are moved more slowly or swiftly, according to their *Bulk*; they that are less in *Bulk* performing their Revolution in less time, than those that are of a greater *Bulk*. Thus *Saturn*, the highest and biggest of all the *Planets*, takes up almost 30 *years* in running through his *Orb*; *Jupiter* 12, *Mars* 2; and so of the rest, according as the *Orbs* they are to run over, are nearer or further from the *Earth*: But if we suppose the Immobility of the *Earth*, all this Order must be overthrown, since not only *Saturn*, but all the *Intermediate Planets* between him and the *Earth*, must be hurl'd about in 24 *hours*: All which things are contrary to the *Phænomena*.

V. *The Motion of the Earth, makes for the Beauty and Order of the World.*

But supposing the *Earth* to be moved, all these things are salv'd, and the comely Order of the *Universe* preserv'd and establish'd. Seeing that we may proceed from the *Earth*, to those *Bodies* that are more slowly moved, without any confusion, till we come to the *Heaven* of *fix'd Stars*. Or if any one should assert the *fix'd Stars* also to be moved, thence will follow another Absurdity, *viz.* that their *Motions* will be *unequal*. For some of them that are in the Greatest *Circles* will be most swiftly moved, and others in the least *Circles*, with a very slow *motion*, according as the said *Circles* shall be further from the *Ecliptick*, and nearer to the *Poles*. Now what can be more absurd, than to suppose *Bodies* to be moved at the remotest distances from the *Center*, and yet to assign the least Spaces to their *motions*?

VI. *If the Earth be unmovable, there must be two contrary Motions in the Heavens.*

Moreover, all those who are of the contrary Opinion, hold, that the *Determination* of a *motion* towards one part, and its meeting of another *Body*, *resting*, or otherwise *moved*, are contrary to one another: Now supposing that the *Heaven* is moved, we shall find divers *motions* in it, one from *East* to *West*, and another from *West* to *East*. For the *Heaven*, according to them, is most swiftly whirl'd towards the *West*; and the *Planets* from *West* to *East*; which two *motions* are *Diametrically* opposite. Now, it is impossible for one and the same *Body* to be carried divers ways *by contrary Motions*: For if a *Body* be carried from *East* to *West*, it cannot at the same time be carried from *West* to *East*.

VII. *These Difficulties are removed by the Motion of the Earth.*

But what still more surpasseth our Apprehension is, How it is possible that whilst the *Heaven* is with such incredible swiftness hurl'd about, the *Planets* should in spight of it perform their Courses in a quite contrary *motion* to it; especially seeing that their *motion*, compared with that of the *Heaven*, is very slow, and therefore may be easily overpowr'd by a stronger *motion*. But by attributing a *Motion* to the *Earth*, all this contrariety of *motions* ceaseth, and we have no more than one *motion*, *viz.* from *West* to *East*, which way the *Earth* and all the *Planets* are carried.

VIII. *'Tis incredible that all the Heavens should be moved about the Earth, and that it should be unmoveable.*

The great Force also of the *Motion* of the *Heavens*, asserted by the Followers of *PTOLOMÆUS* his *Opinion*, is a strong Argument to prove the *Diurnal Circumvolution* of the *Earth*; for they must allow it to be so powerful, as to whirl about with it not only the *Planets*, but also the *fix'd Stars*. Now if it be so that all *Inferiour Bodies* are forc'd to follow the *motion* of the *Highest Heaven*; and that the *Element* of *Fire*, and a great part of the *Air*, cannot resist its *motion*, how is it possible that the *Earth* that hangs in the midst of the *Air*, and is indifferent to *Motion*, or *Rest*, and surrounded with *fluid* Matter, should for all that alone remain *immovable*, and resist so vast a Force? This, according to my sense, seems utterly inconceivable; for by what *Ropes* or other *Holdfasts*, is it kept immovable in this *Æthereal Ocean*? For altho' the *Heavenly* Matter be liquid, and doth not push against other *Bodies*, with as much force as *hard Bodies* do; yet neither can it be denied, but that the *motion* of *fluid Bodies*, when determin'd to some one part, doth carry along with them whatsoever Matter is contained in them, how *solid* or *compact* soever it may be, except it be detained by some outward Force. As we see that great *Stones*, by the strong Current of *Rivers*, are carried along to a vast distance, except they be stopt by the *unevenness* of the *Bottom*, or some other *Obstacle*. Now all these Difficulties vanish by ascribing to the *Earth*, which is a very little *Body*, yea, imperceptible, if compar'd with the *Universe*, and unable to cause any Change in the *World*, a *motion* round its own *Center*.

IX. *It is also contradictory to the Order of Nature.*

Moreover, what shall we assign to be the Cause, that keeps the *Earth* immovable? Is it by some Force? But where shall we look for this *Force*? or what is it? Is it a *Natural Force*, depending on the Divine Order and Constitution, setled in the first *Creation*, and consequently the ordinary *Providence of GOD*? Or is it an immediate *Hand of GOD*? It cannot be the ordinary *Power of GOD*: For the *Order of Nature* is this, that where *Bodies* that are near and far off, are hurried away by another *Body*, there also that which intervenes between those that are near and far off, must be carried about also, except something hinder it. Let us suppose *Lines* to be drawn from the *Sun* through the *Earth* and *Planets*; by which *Lines* we are to conceive the *Sun-beams* to be diffused, according to *TYCHO*, that by them he may carry about with him the Upper and Lower *Planets*; if therefore he snatcheth the superiour *Planets* along with him, must not he of necessity do the same for the *Earth*, which is in the midst between them? Neither can this be said to be done by the immediate *Power of GOD*, since *TYCHO* himself never thought fit to have recourse to any such *Power*, for the making out of his *Hypothesis*.

X. *The Sun being the great Lamp of the World, it would be absurd to conceive it plac'd in a Corner.*

The *Light of Nature* also seconds our Opinion; for those *Bodies* are supposed to be of different *Natures*, which are endued with different *Affections*: Thus *Lucid* and *Opake Bodies* are distinguish'd in their Composition, because they have distinct *Properties*. Wherefore seeing that the *Planets*, of whose number the *Earth* is, are solid and

and deſtitute of all *Light*; it is neceſſary that the *Sun* and *fix'd Stars* ſhould continue unmoved, and that the *Earth* and the reſt of the *Planets*, ſhould move round him, to partake of his *Light*. For as it would be abſurd to place a *Light*, that is to enlighten a *Church*, in ſome *Corner* of it, and not in the midſt: So the *Sun* being deſign'd to be the Great *Light* of the *Univerſe*, by which other *Bodies* were to be illuminated, it was to be placed in the *Center*, and not in one of the *Sides* of it. And accordingly we muſt conclude, that the *Sun* ſtands ſtill, and that the *Earth*, with the reſt of the *Planets*, are carried round him.

XI. *The ſame Effects follow, whether the Earth be ſuppoſed to move or ſtand ſtill.*

Beſides, I cannot conceive what Reaſon ſome *Philoſophers* could have, to maintain the *Earths* Immobility, ſeeing that the ſame Effects follow, whether its *motion* be allow'd or deny'd. For the *Sun* ſeems to us to run through the *Zodiack* after the ſame manner, notwithſtanding that he reſts in the *Center* of our *Vortex*: For whereſoever the *Earth* is, the *Sun* being look'd upon from it, will always hide that *Sign*, in oppoſition to which the *Earth* is placed. Thus when the *Earth* is in *Libra*, the *Sun* is ſeen in *Aries*; and when the *Earth* paſſeth from *Cancer* to *Leo*, the *Sun* is ſeen to paſs out of *Capricorn* into *Aquarius*.

XII. *Some Body muſt reſt, or ſtand ſtill, for to be able to judge of the motion of another Body.*

For ſeeing that no relation can be fixt between *Bodies* that are in *motion*, and it is neceſſary that ſome be *moved*, and others *ſtand ſtill*, that we may be able to form ſome reſpect between them: The ſame Appearances happen to us, whether we ſuppoſe the *Earth* only to be moved, or the *Heaven* with the Circumambient *Bodies*; foraſmuch as by this means the Relation only of a *Body* moving and at reſt, is varied, the ſame effect being indifferently produc'd by either of them, as to us. Now this being ſuppoſed, it will not be eaſie for any one to believe, that *Nature*, which always proceeds the moſt ſhort and compendious way, ſhould have choſen to perform that by the unconceivable *motion* of ſo many vaſt *Bodies*, which ſhe might, without all that ado, have brought about by the alone *motion* of the *Earth*.

XIII. *The Air and Water are whirl'd about with the Earth.*

Theſe and other like *Arguments*, which I might alledge, are ſufficient, as I ſuppoſe, to prove that the *Earth* moves, at leaſt to thoſe who liſten to Reaſon, rather than Authority; eſpecially if they conſider, that the *Globe* of the *Earth* is turned round together, with the Neighbouring *Bodies* of *Water* and *Air*. For as the *Water*, as hath been ſaid already; ſo likewiſe the *Air* makes a part of the *Terreſtrial Globe*, and may be conceived to have the ſame reſpect to the *Earth*, as the *ſoft Down* that grows upon a *Body* hath to it.

CHAP. IV.

The Objections anſwer'd, which by ARISTOTLE and others, are framed againſt the Motion of the Earth.

I. *Objections afford a greater Evidence, to diſcern the truth of the matter in queſtion.*

AS *Lucid Bodies*, compar'd with ſuch as are *Opake*, do thereby appear the clearer; and as the *Sun* ſhines brighter, when newly got from under a *Cloud*: So I queſtion not, but that this Opinion concerning the *Earths motion*, will appear more plauſible by a Refutation of the Objections that Adverſaries make againſt it. Amongſt thoſe who oppoſe this Opinion, *ARISTOTLE* is the Chief; a Man of a great *Wit*, and fit for the Contemplation, not only of *Earthly*, but *Sublime things*: Who 'tis like, had he liv'd in theſe our days, would either have been of our *Opinion*, or at leaſt have better refuted the *Arguments*, which are brought to overthrow the ſtability of the *Earth*.

II. *Ariſtotle's Objection, drawn from the Nature of Natural and Violent Motion.*

The Firſt *Argument* he brings againſt us is, That this *Circumvolution* of the *Earth* is not a *Natural*, but a *Violent motion*; becauſe it is repugnant for that to agree Naturally to any thing, that doth not agree to all its parts likewiſe. Now it is evident that the Parts of the *Earth* do not move ſo, for they are carried in a ſtrait *Line* to the *Center*, wherefore *Circular motion* cannot be ſaid to be Natural to the *Earth*, and therefore much leſs to be everlaſting.

III. *The word* Violent *doth not belong to Natural things.*

This Objection is eaſily anſwer'd, by ſaying, That the word *Violent* doth not at all belong to *Natural things*, foraſmuch as they are indifferent to *Motion* or *Reſt*; and it is no leſs Natural for *Bodies* to be moved, when they are puſh'd forwards by an External Agent; than it is for them to *reſt*, when they are not puſh'd out of their places. It belongs only to our Will to *ſuffer Violence*, when any thing is done that is contrary and adverſe to it. But let us grant that *Violence* may be attributed to *Bodies*, and that there are certain Inclinations in things, by which they proſecute the Ends they are deſign'd for; yet cannot we conclude thence, that the *Earth* is moved againſt *Nature*, becauſe its *parts* are moved downwards by a *ſtrait*, and not by a *Circular motion*: For this is to be underſtood of the *parts* of the *Earth*, ſeparated from the reſt of the *Globe*; and thus conſider'd, it is not neceſſary that they ſhould be in all things like unto the whole: No more than it is neceſſary, that all the *Particles* of the *Earth* ſhould be *round*; or every part of a *Circle*, make a *Circle*, becauſe the whole is Round, and the *motion* of the whole conſtitutes a *Circle*: But only that the *parts* of the whole be moved together with it; and like as the *Globe* of the *Earth* is whirld about in 24 *hours*, ſo all the *parts* that compound it, be in the ſame Space carried about its *Center*.

IV. *Nothing hinders, but that the Motion of the Earth may be Everlaſting.*

Which *Motion* may be no leſs Everlaſting to the *Earth*, than any other *motion*; yea, and more too, if we attend to the Nature of *Strait motion*. For it is certain, that the *Earth* cannot move for ever upwards or downwards: But what can hinder that a *Body* may move Round continually, ſuppoſing the ſame cauſe that produceth it at firſt, to perſevere? Wherefore, according to our *Principle* we are to aſſert, that no *force* or *violence* is to be found in its *Nature*; and that it is no leſs *natural* for *Bodies* to move *Round*, than to move in a *ſtrait Line*, upwards or downwards, or any other way whatſoever.

V. *The ſecond Objection, from the Heavineſs of Bodies.*

The *Heavineſs* of *Bodies* ſeems of all other things to be moſt contrary to the Circumvolution of the *Earth*. For *Heavy Bodies* do from on high, fall to the *Earth* by a *ſtrait Line*: Now ſuppoſing this *Circular motion* of the *Earth*; how can it be, that a *Stone* let fall from the Top of a *Tower*, ſhould fall down plumb to the Bottom of it, when in the mean time that the *Stone* is falling down, the *Earth* that bears the *Tower* moves many Cubits; and therefore the *Stone*, in caſe the *Earth*

were moved, would not light at the foot of the *Tower*, but a good diſtance from it, which is contrary to daily experience.

VI. *A Stone falling down from the top of a Tower, is carried by a twofold motion.*

This *Objection*, tho' accounted of great weight by our *Adverſaries*, is nevertheleſs eaſie enough to be anſwered, if we conſider, that in every *Heavy Body*, beſides its *motion downwards*, there is another impreſt upon it, from the *Earth*, whirling round about its own *Axis*, whereby not only it ſelf, but the *Bodies* that are about it, are carried along. There is therefore a twofold *motion* in a a *Stone* that falls from a *Tower*, the one a *ſtraight motion*, whereby it falls down to the *Ground*, the other a *circular*, whereby the *Earth* is carried along with the *Cæleſtial matter* that ſurrounds it; and therefore it is not neceſſary that a *Stone* fallen down from a *Tower*, ſhould fall at a diſtance from it, ſince both of them are carried about with the ſame ſwiftneſs, and the *Stone* cannot but fall plumb down at the foot of the *Tower*. For it is no contradiction in *Philoſophy* for one *motion* to be compounded of a ſtraight and circular. *ARISTOTLE* himſelf owns as much, when he attributes to the *Fire* a *ſtraight motion*, by which it is carried upwards; and a *circular*, in which it is carried about the *Earth* by the *ſupream Heaven*. A *Stone* therefore falls *plumb* down to the *Earth*, becauſe with reſpect to the *Stone* it is all one, as if it were not mov'd at all, ſeeing that the *Air* and all the *Bodies* contain'd in it, are preſt down by the *ſubtil matter*, and are whirl'd about together with the *Terreſtrial Globe*. This is proved by a *Stone* falling from the *Maſt* of a *Ship*, which whether it move, or ſtand ſtill, the *Stone* ever falls down in the ſame place. The reaſon whereof is plainly this, becauſe the *Stones motion downwards*, which it derives from the *Cæleſtial matter*, is accompanied with a *Lateral motion*, communicated to it by the *Ship*, which is ſwiftly driven along. And conſequently it is not ſtrange at all, that it falls down *perpendicularly*, becauſe the *Stone* moves as much forwards as the *Earth*, and conſequently one and the ſame point of the *Earth* ever anſwers to the *Stone*, and therefore upon it the *Stone* muſt needs fall.

VII. *The motion of a Stone falling down is not ſtraight, but according to a Parabolical Line.*

Tho' indeed to ſpeak exactly concerning theſe things, we muſt own, that *heavy Bodies* do not fall downwards by a Right, or Perpendicular *Line* to the ſurface of the *Earth*, but by a kind of *Tranſverſe* or Crooked, called a *Parabolical Line*: and the Reaſon why the *motion* of a *Stone* appears to be Right and Perpendicular, is, becauſe the *Eye* doth not perceive that *motion* whereby it ſelf is moved, and which is common to it with the *Stone*, but only that *motion* which proceeds from the *Action* of *Gravitation*, or which is impreſt upon the *Stone*, by him that caſts it.

VIII. *A Third Objection from the Shot of a Gun.*

Againſt this Solution it may be, will be urged an *Argument* taken from the Shot diſcharged out of *Great Guns*, *viz.* how it comes to paſs, the *Earth* being moved about its own *Center*, that a *Bullet* diſcharged from the *Eaſt*, ſhould not move more ſlowly than another that is diſcharged from a like *Gun*, and an equal quantity of *Powder* from the *Weſt*? For if the *Earth* be carried from *Weſt* to *Eaſt*, it muſt neceſſarily follow that the *Bullet* diſcharged from the *Weſt*, muſt much exceed the ſwiftneſs of the other, as being aſſiſted and promoted by the Circumvolution of the *Earth* the ſame way; whereas the other is as much obſtructed by the ſame, becauſe it moves a quite contrary way.

IX. *The Anſwer.*

I Anſwer in the *Firſt Place*, that when a *Bullet* is diſcharged towards the *Weſt*, as much as the *Earth* moves towards the *Eaſt*, ſo much is the *Bullet* alſo driven back that way, by the common motion of the *Vortex*: and on the contrary, when a *Bullet* is diſcharged towards the *Eaſt*, as much as the *Earth* haſts the ſame way, ſo much is the *Bullet* retarded by the *Vortex* of the *Earth*.

X. *A common or general motion is no obſtacle to particular motions.*

I Anſwer in the *Second Place*, that the *motion* of the *Earth* which is common to it with the *Air*, and other *Bodies* contained in it, doth neither hinder nor promote the *motions* of particular *Bodies*; and conſequently, that all things happen in the ſame manner, as if the *motion* of the *Earth* were not determined to any certain part. As is manifeſt from this *Example*. Suppoſe we, a *Boat* to be driven with great ſwiftneſs to ſome particular *Region*, and one part thereof to be full of *Water*, in which two *Fiſhes* are *ſwiming*, the one from the *Eaſt* to the *Weſt*, and the other from *Weſt* to *Eaſt*; no body will imagine, that that *Fiſh* whoſe motion conſpires with that of the *Boat*, will therefore move faſter than the other. For it is certain, that which way ſoever they move, it will be with equal ſwiftneſs, as if the *Boat* were not moved at all. Thus the *motion* of the *Earth* from *Weſt* to *Eaſt*, is no hinderance at all to thoſe *Bodies* that move the contrary way. Yea the motion being common, its the very ſame, as if there were none at all.

XI. *The motion of a Bullet diſcharged from a Gun, compared with the motion of Fiſhes in a Boat.*

For as theſe *Fiſhes*, beſides the motion they have from their *Animal Spirits*, whereby they are carried which way they pleaſe, have alſo a motion impreſt upon them from the *Boat*: In like manner a *Bullet*, beſides that *motion* communicated to it by the *Gunpowder*, which carries it ſtraight forward, hath another *motion* impreſt upon it by the *Earth*, whereby it is whirl'd about in the ſame ſwiftneſs with it from *Weſt* to *Eaſt*, and therefore runs through the ſame ſpaces as if there were no motion at all in the *Earth*.

XII. *A fourth Objection from the Nature of the Winds.*

Others again raiſe this Objection againſt the *motion* of the *Earth*: Suppoſing the *circumvolution* of the *Earth*, ſay they, there would always be a ſenſible Breez of *Wind* upon the *Surface* of it, as we perceive when we ride on *Horſeback*, we are ſenſible of a kind of a *Breez* of *Wind* coming againſt our *Faces*, becauſe the *motion* of the *Horſe* exceeds the *motion* that is in the *Air*. Accordingly what a ſtrong *Breez* of *Wind* ought we to feel, if with ſo ſwift a whirling about, as that of the *Earth* is ſuppoſed to be, we ſhould run againſt the oppoſing *Air*? Wherefore ſeeing we find nothing of this, we have reaſon to conclude, that there is no ſuch motion at all.

XIII. *Foraſmuch as all the Bodies up to the Moon are moved together with the Earth, it cannot ſeem ſtrange that we feel no wind from the motion of the Earth.*

But this Objection is not ſo much the effect of *Reaſon*, as of an inverate Prejudice about the ſtability of the *Earth*, which makes it a difficult thing for ſome men to conceive, that the *Air*, with all other ambient *Bodies* to the *Moon*, are carried about together with the *Earth*. Whereas, to ſpeak exactly, the *Heavenly matter* that carries the *Earth* along with it, is more ſwiftly moved about the *Earth* than the Earth it ſelf is about its *Axis*. Wherefore, in this Caſe, no wonder if we feel no *Wind* at all, no more than it is ſtrange that a man that

IX.
The An-
swer.

X.
A common
or central
motion is
no obstacle
to particu-
lar motions.

XI.
The motion
of a Bullet
discharged
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compared
with the
motion of
Fishes in a
Boat.

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For so much
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from the
motion of
the Earth.

that purſues us with a *Sword* doth never reach us, in caſe we move faſter than he.

XIV. *A Fifth Objection from Holy Scripture.*

The Authorities taken from *Scripture* ſeem to be of more force againſt this Opinion: For the *Scripture* in may places *attributes ſtability* to the *Earth*, and to the *Sun* a *motion* from *Eaſt* to *Weſt*, as in the 1*ſt* Chapter of *Eccleſiaſtes*, where it is ſaid, *The Sun ariſeth, and goeth down, and haſteth to his place where he aroſe.* And in the Book of *Joſhua* it is reported for a *Miracle*, that the *Sun* ſtood ſtill at the Prayer of *Joſhua*, when he ſaid, Chap. 10. 12. *Sun, ſtand thou ſtill upon Gibeon.* Now this would not have been a *Prodigy*, if the *Sun* had always ſtood ſtill in the midſt of the *World*, and the *Earth* had whirl'd about it; for if ſo, it had been more proper for *Joſhua* to have ſaid, *Earth, be not thou moved.*

XV. *The Scripture in may places accommodates it ſelf to our manner of conceiving of things.*

To which I Anſwer, That it is generally owned, that the *Scripture* ſpeaks of things according to the manner of *men*, that is, our way of conceiving them. As when the *Scripture* ſpeaks of the *Ends* and *Foundations* of the *Earth*, neither of which do properly belong to it. In like manner, when it attributes to the *Sea*, an *Abyſs* of an unmeaſurable depth, with other various *Affections* and *Motions*, which it hath not. Thus likewiſe it is ſaid in the 1*ſt*. Chapter of *Geneſis*, that *God made two Great Lights, the Greater to rule the Day, and the Leſſer to rule the Night.* Which can only be underſtood as to outward appearance, and not according to exact *Truth*. Becauſe the *Sun* and *Moon* are not the greateſt *Lights*, eſpeally not the *Moon*, for *Saturn* and any of the *Fixt Stars* are greater than it. Neither can the *Moon* be called abſolutely the leaſt *Light*, ſeeing that *Mercury* is much leſs. And therefore we muſt conclude, that the *Scripture* calls them ſo, only becauſe they appear ſo to us, and are accounted ſo according to *vulgar* opinion. And upon the ſame account it is, that the *Earth* in *Scripture* is ſaid to *ſtand ſtill*, and the *Heaven* to move about it; becauſe, as to our ſight, the *Earth* ſeems rather to ſtand ſtill, and the *Sun* to be whirl'd about it, than the contrary. The ſame thing happening to us in this caſe, as to thoſe that *Sail*, to whom the *Shoars* ſeem to withdraw, tho' indeed they withdraw or depart from the *Shoar*. When therefore *Joſhua* ſaid, *Sun, ſtand thou ſtill*, this is not to be underſtood, as if the *Sun* then had been ſtopt in his *motion*, and made to ſtand ſtill; but only that the *Light* of the *Sun*, at *Joſhua*'s Prayer, continued without change, by which means the *Body* of the *Sun* ſeem'd to ſtand.

XVI. *The Objection farther urged from Scripture.*

If it be urged, that this Explication cannot be admitted, foraſmuch as in many other places of *Holy Scripture* the *ſtability* of the *Earth* is plainly aſſerted: As in the 92 *d*. Pſalm, *The Earth is eſtabliſhed, that it cannot be moved*, and the 1 *ſt*. of *Eccleſiaſtes*, *One Generation paſſeth away, and another cometh, but the Earth ſtandeth for ever.* For how can the *Earth* be ſaid to ſtand faſt for ever, when indeed it is continually in *motion*?

XVII. *The Objection anſwered.*

I Anſwer, that theſe places are not ſo to be underſtood, as if the *Earth* were immoveable, and did not turn about its own *Axis*, but only that there is ſuch a firm and indiſſoluble union of its parts, that it continues the ſame, notwithſtanding the perpetual generation and corruption of *Animals*, *Plants*, and other things that are upon it. So as that paſſage of the *Poet* may be attributed to the *Earth*.

The ſame that our Progenitors did ſee,
The ſame is now, and ſtill ſhall be.

And that this is the *genuine ſenſe* of this place, plainly appears from the foregoing words, *one Generation paſſeth away, and another cometh.* As if it had been ſaid; tho' the *Earth*, according to ſome of his *parts*, be changed by means of *Generation* and *Corruption*, yet it ſtandeth for ever, that is, it always continues in the ſame ſtate: Much after the ſame manner as a *Ship* is ſaid to continue the ſame, though it hath been often repaired, and ſeveral new *Parts* put inſtead of the old and decayed.

CHAP. V.

Concerning Day and Night, and the Viciſſitudes of Seaſons.

I. *What a Natural and Artificial Day is.*

A *Day* is commonly taken by *Philoſophers* for the *ſtay* of the *Sun* above the *Horizon*: In which ſenſe it is oppoſed to *Night*, which is the abode of the *Sun* under the *Horizon*. Or elſe a *Day* is taken for that *Duration* in which the *Sun* is conceived to run round the whole *Earth*. The *Aſtronomers* call the former of theſe an *Artificial*, and the later a *Natural Day*, as containing both the *Artificial Day* and *Night*.

II. *A Natural Day is either Aſtronomical or Civil.*

A *Natural Day*, is either *Aſtronomical* or *Civil*. An *Aſtronomical Day* is that ſpace of time, wherein the whole Revolution of the *Æquator* is abſolved, together with that portion of the *Æquator*, which anſwers to that part of the *Ecliptick*, which the *Sun* in the ſame time is underſtood to run through. The *Civil Day*, is that which is determined as to its *Beginning* and *Ending*, according to the cuſtom of particular *Cities* or *Nations*. Thus the *Italians* begin their *Day* from *Sun* ſet; the *Babylonians* from the *Riſing* of the *Sun*; the *Umbrians* from *Noon*; the *Romans* from *Midnight*, &c.

III. *What a Year is.*

A *Year*, which conſiſts of *Days* and *Nights*, is that *time*, wherein the *Sun* runs through the whole *Ecliptick*, or all the Signs of the *Zodiack*; which it doth in 365 days, 5 hours and 49 minutes; Which form of the *Year*, that it might be obſerved throughout the whole *Roman Empire*, *Julius Cæſar* appointed that the 5 hours, with the 49 minutes, which the *Year* contained over and above the 365 days, ſhould every fourth *Year* make one *Day*, which ſhould then conſiſt of 366 *Days*.

IV. *Why a Year is not the ſame every where, and why the Engliſh differ in their computation from ſome other Nations.*

But foraſmuch as theſe 20 *hours* with their *minutes* could not make up a whole Day, it was ſo ordered that thoſe *minutes* which were added to every *Year*, over and above the due length of it, by proceſs of time were ſo increaſed, as by exact computation to amount to 10 days. And conſequently alſo the *Vernal Æquinox* had changed its place, ſo as that the *Sun*, which entred *Aries* at the beginning of *Chriſtianity*, on the 21*ſt* day of *March*, did about 1500 years after, enter the ſame about the 11*th*. day. To remedy which error, Pope *Gregory* XIII. reſtored the *Æquinox* to its former Seat, and by taking away 10 days, made it to return to the 21*ſt* of *March* again. Which is the Reaſon

Reaſon why we here in *England*, not receiving this Reformation of the *Kalender*, differ 10 days from the account of others; ſo that when in *France* it is the 11*th.* day of *March*, it is no more than the 1*ſt.* day with us, and ſo on.

V. *A threefold Revolution of the Earth.* Foraſmuch as the Diverſity of the *Days*, *Nights* and *Seaſons* of the *Year*, are conſequent upon the *motion* of the *Earth*; we are to take notice of a threefold *motion* in the *Earth*, *viz.* A *Diurnal*, *Annual*, and *Motion* of *Inclinations*.

VI. *The Diurnal motion of the Earth.* The *Diurnal motion*, is that whereby the *Earth* is whirl'd about from *Weſt* to *Eaſt*, in the ſpace of 24 *hours*. This *motion*, according to our *Hypotheſis*, doth not properly belong to the *Earth*, but to the *fluid matter*, in the midſt whereof the *Earth* being poiſed, is together with the *Atmoſphere*, carried about, not by a motion of its own, but of the *Fluid Heaven* that ſurrounds it: ſo that according to *DES CARTES* his Opinion, *motion* doth not properly belong to the *Earth*, but to the little *Vortex* which carries the *Earth* round with it ſelf.

VII. *The Annual.* The *Annual motion*, is that whereby the *Earth* runs through the *Ecliptick* in a years time; which *motion* is alſo imparted to it by the *Fluid matter*, whereby it is pois'd, which being whirl'd round by the force of the *Solar matter*, doth neceſſarily carry about with it all the *Bodies* that *Swim*, or are poiſed in it. The *Earth* therefore being carried about the *Sun*, between the *Orbs* of *Venus* and *Mars*, runs through the 12 *Signs* of the *Zodiack* in a *years* time. Now how the *Earth* can, beſides its turning round, about its own *Axis*, perform a circuit about the *Sun*, we may learn by the Example of a *Top*, which turning round upon your *Hand*, may by you in the mean time be carried round a *Tree*, without hindring the *motion* of it about its own *Center*.

VIII. *The Earths motion of Inclination.* The *motion of Inclination* or *Declination* of the *Earth*, is the *Deflexion* of its *Axis*, from a *Paralleliſm* with the *Axis* of the *Ecliptick*, and ever keeping it ſo in every *Situation*, that it may always continue *Parallel* to the *Axis* of the *World*. So that indeed this *motion*, is not ſo much a diſtinct *motion* from the foregoing *motions*, as a certain modification of them; for whilſt the *Earth* abſolves its *Diurnal* and *Annual motion*, it always hath its *Poles* directed to the ſame parts of *Heaven*.

IX. *This threefold Motion of the Earth explained.* Theſe three *motions* of the *Earth* will be apprehended without difficulty, by comparing the two former to a *Bowl* delivered out of ones *Hand*, and rowling along the ground: and the *third* to a Flag fixt to the Maſt of a *Ship*, but ſo, as to be able to turn round, in which Flag we ſuppoſe the *Globe* of the *Earth* to be painted, with its *Axis*, not placed right upwards, but ſomewhat leaning on one ſide, *parallel* with the *Axis* of the *Terreſtrial Globe*. Now ſuppoſe a *Ship*, in which a *Maſt* and *Flag* is, were to *ſail* round ſome *Caſtle* or *Fort*, a ſtrong *South Wind* blowing, it is manifeſt that this moveable *Flag* on the top of the *Maſt*, would not turn about with the *Ship*, but by the force of the *Wind*, would be always directed towards the *North*, together with the *Axis* painted in it. So that by that time the *Ship*, purſuing its *courſe*, had performed one round, about the *Fort*, the *Flag* alſo would have perform'd one round, about the *Iron Pin* to which its faſtned, contrary to the *motion* of the *Ship*; the *Axis* of the *painted Globe* of the *Earth* being ſtill directed towards the ſame part of *Heaven*.

X. *The Great Orb, is but a Point in compariſon with the fix'd Stars.* The *Orb*, whoſe middle Line the *Earth*, by its *Annual motion* deſcribes, is called the *Great Orb*, which with regard to the *fix'd Stars* is but like a *Point*, according to our *Hypotheſis*, ſo great is the *diſtance* between the *fix'd Stars* and the *Earth*; and therefore 'tis all one, whether the *Stars* be viewed from the *Center* of this *Great Orb*, or from the *Circumference*. And thus much will be readily admitted by thoſe who conſider how raſh a thing it is, to define the *Works* of *GOD* to be leſs Auguſt and Ample, than indeed they are; and eſpecially if we conſider, that the *Appearances* can no other way be explained; neither doth Reaſon oppoſe it, ſeeing that the whole *Earth* is but a *Point*, compar'd with the *Sun*: Which is prov'd by this Inſtance, becauſe the *Sun* ſeems to move about a *Round Sun-Dial* placed upon the *Surface* of the *Earth*, after the ſame manner as it Rolls about the *Earth*; which ſhews, that the *Diameter* of the *Earth* is of no account in this caſe.

XI. *The Pole of the Earth declines 23 Degrees from the Pole of the Ecliptick.* It is to be noted alſo, that the *Axis* about which the *Earth*, in a *Days* time, turns round, is not perpendicularly raiſed above the Plain of the *Ecliptick*, in the which, in a *years* time, it is whirl'd about the *Sun*; but declines above 23 *Degrees* from a *Perpendicular*. The reaſon whereof is, becauſe the *ſtriate Matter* of the *firſt Element*, which enters into the *Poles* of the *Earth*, near to the *Poles* of its *Axis*, coming from that part of the *Vortexes* which conſtitute the *ſecond Heaven*, doth in this manner inflect or turn it aſide: The other Parts of the *Earth* having not their *Pores* ſo diſpos'd, that other *ſubtil Matter*, coming from other parts of *Heaven*, ſhould enter into them, and turn it another way.

XII. *Without the Motion of Inclination, there could be no difference of Seaſons.* The Neceſſity of the *Motion* of the *Axis* of the *Earth* appears from hence, that without it there would be no *inequality* of *Days* and *Nights*, but the *Inhabitants* of the ſame place would always have the ſame length of *Days* and *Nights*, and the ſame conſtitution of the *four Seaſons* of the Year; that is, ſome would have all the year, *Winter*, others *Summer*, others *Autumn*, and others *Spring*. Wherefore it is of abſolute neceſſity to admit the *motion* of *Inclination*, to ſalve the *Appearances*, and to make all things agree in Harmony.

XIII. *How Days and Nights come to be.* Foraſmuch therefore as the *Earth* is a great *Spherical Body*, and at a great diſtance from the *Sun*, its whole extenſion cannot be enlightned at once, but only *one half* of it; and therefore when the *Earth* is once carried about its *Axis* A B in the ſpace of 24 *Hours*, it makes the ſame part of the *Earth*, when turn'd toward the *Sun*, to enjoy *Day-light*; and when turn'd away from him, to have *Night*. For *Day* is ſaid to be in that Part of the *Earth*, which being turn'd to the *Sun*, receives its *Rays*; and *Night* in that Part, which being turn'd from the *Sun*, cannot immediately receive them. And therefore it is no wonder, if the *Parts* of *Heaven* ſeem to ariſe and go down; becauſe by the *Revolution* of the *Earth* they are gradually diſcovered, and ſeem in order to approach towards us; and on the oppoſite ſide to ſet and vaniſh. Figure 39.

And

XIV. *Whence the diversity of Seasons of the Year ariseth.*

And because the *Axis* of the *Earth* A B, (as hath been said already) about which its *Diurnal Revolution* is performed, doth at present decline almost 23 *Degrees* from the Perpendicular 1, 6 of the *Ecliptick*, in which the *Earth* in a *Years* time performs his *Course* round the *Sun*; it so is, that the *Earth*, in various parts of its *Orb*, by objecting these two *Poles* of the inclined *Axis*, more or less, turned to or from the *Sun*, and exposing its several *parts*, sometimes for a longer, at other times for a shorter Space to the *Sun*, doth by this means produce the different *Seasons* of the *Year*, and the *Inequality* of *Days* and *Nights*. So that that part of the *Earth* which hath its *Axis* more inclin'd towards the *Sun*, enjoys *Summer*, as admitting the more direct *Rays* of the *Sun*, and consequently stronger and hotter: Whereas in that part which hath its *Axis* more turn'd away from the *Sun*, it is *Winter*, because it receives the *Rays* of the *Sun* more obliquely, and consequently more scatter'd and less agitated. And that *part* which continues longer turn'd toward the *Sun*, enjoys *longer Days*; as that which is for a less time illustrated by the *Sun*, has *shorter Days*.

XV. *There are four Signs, to which when the Earth approacheth, she produceth the different Seasons of the Year.*

This will appear more manifest, by shewing how the *Seasons* come to be, and how it happens that with some *Inhabitants* of the *Earth* it is *Spring*, with others *Summer*, with others *Autumn*, and with others *Winter*. Let us place therefore 4 Points, *Libra* ♎, *Capricorn* ♑, *Aries* ♈, and *Cancer* ♋, as *Centers*, or 4 Equal *Circles*, that may represent the *Earth* to us, placed there at divers *Seasons*; the *Earth* with its *Center* running through the whole Circumference of *Libra*, *Capricorn*, *Aries* and *Cancer* in a years time, from *West* to *East*, according to the *Order* of the *Signs*.

XVI. *How Spring comes to be.*

For it is manifest, that the *Earth* being placed in the *Point* of *Libra* ♎, at the same time that the *Sun* is in the opposit *Sign* of ♈, *Spring* time begins with us, who inhabitate the North parts of the *Earth*; because the *North Pole* of the *Earth* A, being constituted between its past greatest *Declination* from the *Sun*, and its future greatest *Inclination* to it, makes, that the *Sun-beams* falling upon our *Temperate Zone* 1, 2, reach it only obliquely; and therefore make the *Air*, yet thick and sluggish by reason of the *Winters Cold*, more temperate about this time of the *Year*. And forasmuch as both the *Poles* A B, about which the *Earth* is carried by its *Annual Revolution*, are constituted in the Extream parts of the *Hemisphere* of the *Earth*, that is illuminated by the *Sun*; by this means it comes to pass that we, and all other *Inhabitants* of the *Earth* have equal *Days* and *Night*.

XVII. *How we come to have Summer, and those who live in the South parts Winter at the same time.*

But when the *Earth*, in its *Annual Revolution*, comes nearer to *Capricorn* ♑, the *North Pole* A, doth further enter into the *Hemisphere*, illuminated by the *Sun*; whereas the *Southern Pole* B, is more withdrawn from it. By which means it comes to pass, that to those who live towards the *North Pole* A, the *Days* begin to increase, and the *Heat* to prevail; whereas those who live about the *South Pole* B, experience the contrary. But when the *Earth* is come quite to *Capricorn* ♑, *viz.* at the same time that the *Sun* appears in *Cancer* ♋, we enjoy *Summer*; because the *North Pole* A being at that time most inclined towards the *Sun*, it makes the *Sun-beams* to fall directly, and almost perpendicularly upon our *Temperate Region* 1, 2, and the *Cold Region* 1, A; and therefore produceth the greatest *Heat*. But to them who live beyond the *Æquator* 3, towards the *South Pole* B, *Winter* happens at the same time; because the *Antartick Pole* being at that time in his furthest *declination* from the *Sun*, the *Beams* thereof reach it very obliquely and consequently impart but very weak *Light* to them. At the same time the *Longest Days* are with us, and the *Heat* increaseth; because the *North Pole* A continuing for a long time in that *Hemisphere* of the *Earth* which is illustrated by the *Sun*, makes us to enjoy the *longest Days* and *shortest Nights*. The contrary to which happens to the *Southern Inhabitants*, because the *Antartick Pole* B, is then entred into the *Darkned Hemisphere*; and therefore makes, that those who inhabit the *temperate Zone* 4, 5, and the *Cold* 5 B, are for many *Hours* overwhelm'd with *Darkness*, and enjoy the *Light* but a very little Space.

XVIII. *How it comes to be Spring with us, and Autumn with those who live towards the South Pole.*

Afterwards, when the *Earth* having left *Capricorn* proceeds to *Aries* ♈, the *North Pole* A, doth more and more decline from the *Sun*, towards the *Hemisphere* of the *Earth* that is cover'd with *Darkness*; but the *Antartick* B, towards the *illuminated Hemisphere*, which causeth the *Days* to be shortned to us, that live North; whereas those that live *South*, begin to have their *Days* and *Heat* increased: 'Till at last the *Earth* being arriv'd at *Aries* ♈, both the *Poles* being in the Extremes of both the *Hemispheres*, *viz.* of that which is enlightned, and that which is *Darkned*, produce Equal *Days* and *Nights* to all the *Inhabitants* of the *Earth*.

XIX. *How it comes to be Winter with us, and with the Inhabitants of the South Summer.*

Last of all, As the *Earth* continues his Course from the Point of *Aries* ♈, towards *Cancer* ♋, the *Artick Pole* A by degrees begins to enter the *darkned Hemisphere*, and the *Antartick* or *Southern Pole*, the *illuminated Hemisphere*: By which means it comes to pass, that they who live beyond the *Æquator* 3, begin to have longer *Days*; and they shorter, who live towards the North: Till the *Earth* being arriv'd at *Cancer* ♋, the *North Pole* becomes dipt 23 *Degrees* in the *darkned Hemisphere*, and thus makes *Winter* and the *shortest Day* to the Northern *Inhabitants*; whereas to those that dwell in the South, it makes *Summer* and the *longest Day*. Lastly, the *Earth* proceeds from the Point of *Cancer* ♋, to *Leo* ♌, and *Virgo* ♍; till that being arriv'd again at *Libra* ♎, it restores *Spring* to those of the North, and *Autumn* to those of the South.

XX. *Why the Seasons are every year alike.*

All the foresaid *Seasons* of the *Year*, as to the *length* and *shortness* of the *Days* and *Nights*, in the continual process of *Years*, are much alike; because the *Diurnal* and *Annual Revolution* of the *Earth*, whence the Vicissitudes of *Days* and *Nights* do arise, are in all years much alike.

XXI. *How the Poles of the Æquator and Ecliptick come to approach to one another.*

However, because the two Conversions of the *Earth*, *viz.* the *Annual* and *Diurnal*, would be more commodiously performed, if they were done about *Parallel Axes*, the Causes that hinder this are by degrees changed; whereby it comes to pass, that in process of time this *declination* of the *Ecliptick* from the *Æquator* will grows less and less.

CHAP. VI.

Of the Zones and their Inhabitants, and of the Climats.

I. *There are five Zones in the Earth; and what we are to understand by the word* Zone.

THE *Ancients*, to distinguish the Degrees of *Heat* and *Cold* on the *Surface* of the *Earth*, did divide it into 5 *Zones*, *viz.* into the *Torrid Zone*, 2 *Temperate*, and 2 *Cold Zones*. By the Name *Zone* they understood a space of the *Earth*, lying between the two *Tropicks*; or one of the *Tropicks*, and the next *Polar Circle*; or between either of the *Polar Circles*, and the Neighbouring *Pole*. So that the *Zones* are nothing else, but *different Regions of the Earth differing in Temperature, according to the Suns Nearness, or Distance.*

II. *The Torrid Zone.*

The *Torrid Zone*, is that Space which is comprehended between the *Tropicks*; the Northern part whereof reacheth 23 *Degrees and an half* from the *Æquator*; and the other part, as far towards the South: So as that the whole Space contains 47 *Degrees* in *Latitude*; and is therefore called the *Torrid Zone*, because it is scorched by the perpendicular *Beams* of the *Sun*.

III. *The Temperate Zones.*

The *Zones* that are placed between the *Tropicks* and the *Polar Circles*, are called *Temperate*; the one of them being between the *Tropick* of *Cancer* and the *Artick Circle*, which is 43 *Degrees* broad. And this is called the *Temperate Zone* towards the *North*. The other is call'd, the *Temperate Zone* towards the *South*, between the *Tropick* of *Capricorn* and the *Antartick Circle*, and hath as many *Degrees* in *Latitude* as the former.

IV. *The Frigid Zones.*

The other two which are comprehended within the *Polar Circles*, are called *Frigid* or *Cold*: Whereof one is the *Northern Frigid Zone*, between the *Artick Circle* and the *North Pole*; from which *Circle* to the *Pole*, are accounted 23 *Degrees and an half*. The *Southern Frigid* lies between the *Antartick Circle* and the *South Pole*, and is just as many *Degrees* in *Latitude*.

V. *The Torrid Zone is not inhabitable, as was believ'd by the Ancients.*

The *Ancients* believ'd the *Torrid Zone* to be Inhabitable; according to that of *Ovid*,

——*of these, the Middle* Zone,
Is scorch'd with Heat, *inhabited by none.*

But Experience hath now better inform'd us; for the *Spaniards*, *Portuguese*, *Hollandors*, and also the *English*, who have *Sailed round the World*, as they call it, have found the *Torrid Zone* not to be scorch'd with intolerable *Heat*, but *Temperate* enough, and water'd with plentiful *Showers*, and with frequent *Rivers* and *Springs*, abounding also with all manner of *Fruit* and *Corn*, and affording a pleasant and delightful Abode to *Animals* and *Men*, so as that *People* of several *Nations* come to inhabit there. This appears also consonant to Reason; because the Length of the *Nights*, which are equal to the *Days*, in those Regions, doth greatly allay the *heat* of the *Air*. Neither are there wanting in this Space many *Lakes*, *Pools*, and other moist places, whence copious Vapours are raised, which afterwards coming down in *Rain*, do allay and temper the *heat* of the *Sun*. For tho' the *Rains* that fall there be but *small*, yet they are so frequent, as sometimes to continue for some *Months* together, greatly favouring the growth of *Plants*, and conducing to the refreshment of *Men*, and other *Living Creatures*. Which inclines me to be of *Polybius* his Opinion, who asserts that part of the *Earth* under the *Æquator* to be more *Temperate*, than that which is under the *Tropicks*; because when the *Sun* is about the *Æquator*, he presently runs over the *Vertical Point*; but when at the *Tropicks*, he continues *Vertical* for several *Days*.

VI. *The Inhabitants of the Torrid Zone, are in a threefold difference.*

There is a difference amongst the *Inhabitants of the Torrid Zone*: For some of them live under the *Æquator*, others under the *Tropicks*, and others again between the *Æquator* and the *Tropicks*. The *Sun* toucheth the *Zenith* or *Vertical Point* of all these, once or twice every *Year*. They who live under the *Æquator*, in the *first* place, have a *Right Sphere*: *Secondly*, They alone enjoy a *Perpetual Æquinox*: *Thirdly*, They alone have the view of both *Poles*: *Fourthly*, To them alone all the *fix'd Stars* Rise and Set: *Fifthly*, They have two *Summers* and two *Winters*: *Sixthly*, The *Sun* passeth their *Zenith* twice in a *Year*. Those who live under the *Tropicks* do *first* experience two *Meridional Shadows*, in a *Years* time: *Secondly*, They have but one *Summer*, and one *Winter*: And *lastly*, The *Sun* reacheth their *Zenith* once in a *Year*. They who live betwixt the *Æquator* and the *Tropicks*, have 3 *South shadows* in a *Year*; in the next place they have 2 *Summers* and 2 *Winters*, especially if they be more remote from the *Tropicks*: *Thirdly*, The *Sun* passeth their *Zenith* twice in a *Year*.

VII. *The Inhabitants of the Temperate Zones.*

The *Inhabitants* of the *Temperate Zones*, in the *first* place, have one *South shadow* in a whole *year*: *Secondly*, They have two *Solstices*: *Thirdly*, They have one *Summer* and one *Winter* in a *year*: *Fourthly*, The *Sun* never reacheth their *Vertical Point*: *Fifthly*, They have 2 *Æquinoxes* every *year*, as all those have that have an oblique *Sphere*, or that dwell betwixt the *Æquator* and the *Poles*.

VIII. *The Inhabitants of the Frigid Zones.*

The *Inhabitants* of the *Frigid* or *Cold Zones*, are of 3 sorts: For they either live under the *Polar Circles*, or under the *Poles* themselves; or betwixt the *Circles* and the *Poles*. They who live under the *Polar Circles*, do alone enjoy a *Day* of 24 *Hours* long; and all other things which happen to the *Inhabitants* of the *Temperate Zones*, happen also to them. They who live under the *Poles*, have a *Day* of 6 *Months*, to which succeeds a *Night* of the same length. They have never any *Æquinox*, and to them alone no *fix'd Stars* ever Rise or Set. But they who live betwixt the *Poles* and the *Polar Circles*, their longest *Day* in the *Summer* is above 24 *Hours*. They do not see the *Sun*, whilst he is in the *Tropick* of *Capricorn*. Other things they have common with those that live under the *Polar Circles*.

IX. *The difference of the Inhabitants of the Earth, with respect to their situation.*

Another Distinction of the *Inhabitants* of the *Earth* is taken from the opposite situation of their *Habitation*; and this Difference is Threefold, being distinguish'd into *Periœci*, *Antœci*, and *Antipodes*.

X. Periœci.

They are call'd *Periœci*, who live under the same *Parallel*, and the same *Meridian*, but yet under the opposite Points thereof. Such are those who live in the places marked 7 and 8, and 3 and 6. Now all these have the same *Summer* and *Winter*, and much the same Temperature of the *Air*, and the same Length and Shortness of *Days* and

Fig. 40.

and *Nights*; but have their *Day* and *Night* at a contrary time to one another: Except they be placed within the *Frigid Zone*, because then it may so happen, that they have the same *Day* and *Night*.

XI. Antœci. *Antœci* are those that live under *Parallels*, that are equally distant from the *Æquator*, and under the same *Meridian*, in the same *Longitude*. Such are those who dwell in the *Points* 9 and 7, and in 6 and 8. They have the same *Noon* and *Midnight*; but have their *Summer* and *Winter* at opposite times: So as that the longest *Day* of one of them, is the shortest *Day* of the other. The *Antœci* between the *Tropicks* may have the same *Winter*, but never *Summer* at the same time.

XII. Antipodes. *Antipodes*, or *Antichthones*, are those who live under *Parallels* or *Points* distant the same *Latitude* on either side of the *Æquator*; or under the *Æquator* it self, but yet in opposite Points of the same *Meridian*: Or more briefly, as *Cicero* has it, *Antipodes are those whose steps are opposite to each other.* And such are they who live in 1 and 2, 5 and 4, 6 and 7. The *Antipodes* without the *Æquator*, 5 and 4, have all things opposite. Those at 5 and 4, have *Night* and *Day* quite contrary: And all the rest have also their *Summer* and *Winter* at contrary times. There is no Point assignable on the *Surface* of the *Earth*, to which an *Antipodal Point* doth not answer; and this is nothing else, but the other Extremity of the *Diameter* from the foresaid Point, passing through the *Center* of the *Earth*. Whence it is, that these great Varieties must needs happen.

XIII. *The Opinion of the Ancients concerning the Antipodes.* Those who are our *Antipodes*, live towards the *South Pole*, and are yet undiscover'd what kind of *People* they are; but the *Antipodes* of other *Nations* are known. For though some Great Men of Old did deny *Antipodes*, as supposing that if any such were, they must hang in the *Air*, and have their *Heels* higher than their *Heads*; yet these are worthily derided by *Lactantius*, *Lib.* 4. *cap.* 14. *de Falsa Sapientia*; forasmuch as the *Inhabitants* of the *Earth*, in what part soever they live, tread upon the *Earth* with their *Feet*, which every one may easily understand that considers the *Earth* to be *Round*.

XIV. *Why the Surface of the Earth was divided into Climats.* But because the Distinction of *Zones* did not seem sufficient to the *Ancients*, to specifie all the diversity of the Situations of *Regions* about the *Æquator*, they thought convenient to add many *Parallels*, by which, as by so many lesser *Zones* they divided the *Earth*, and called them *Climats*, as being so many Inclinations or Deflexions from a *Right Sphere*. Yet there is this difference betwixt the *Parallels* and *Climats*; that the *Parallels* are only of one Quarter of an Hour, but the *Climats* of Half an Hour. So that in whatsoever place of the *Earth* the *Solstitial Day* is one Quarter of an Hour longer than 12 *Hours*, that place is under the *first Parallel*. But if the Excess reach to Half an *hour*, that place is situate under the *second Parallel*; or, which is the same, under the *first Climat*. For by *Climats* the *Ancients* understood nothing else, but large Spaces of the *Earth*, or *Zones*, between two *Circles Parallel* to the *Æquator*, equal in *Latitude*, and passing through every 10*th Degree* of the *Meridian*. These are 18 in all, 9 whereof are called *Northern*, and 9 *Southern*.

XV. *The first Northern Clime, is that which is call'd* Æthiopicum. The *first Climat*, from the *Æquator* towards the North, hath its beginning where the Longest Day is of 12 *Hours*, and its *Latitude* or distance from the *Æquator* is 10 *Degrees*; towards the further part of which, the Longest Day is 12 *Hours*, 35 *Minutes*. It is commonly called *Æthiopicum*, from the Country of *Æthiopia*, as passing over the City *Meroe*. For the Custom of the *Ancients* was, to put the Name of some Famous place contained in it upon the several *Climats*.

XVI. *The second*, Arabicum. The *second Climat* is that, where the *Latitude* is of 20 *Degrees*, and the Longest day of 13 *hours* and 12 *minutes*, and is called *Arabicum*, from *Arabia Fœlix*, through which it passeth.

XVII. *The third*, Ægyptiacum. The *third* is that where the *Latitude* is of 30 *Degrees*, and the Longest day of 13 *hours* and 56 *minutes*: And took the Name *Ægyptiacum* from *Alexandria*, the Metropolis of *Ægypt*, through which it passeth.

XVIII. *The fourth*, Syriacum. The *fourth Clime* is that, where the *Latitude* is of 40 *Degrees*, and the Longest day of 14 *hours* and 51 *minutes*. It is called *Syriacum*, because it passeth through *Rhodes* in *Syria*.

XIX. *The fifth*, Italicum. The *fifth* is, where the *Latitude* is of 50 *Degrees*, and the Longest day of 16 *hours* and 9 *minutes*; and it was call'd *Italicum*, or *Gallicum*; because it passeth through *Rome* and *Paris*, where the Longest day is of 16 *Hours*.

XX. *The sixth*, Britannicum. The *sixth* is where the *Latitude* is of 60 *Degrees*, and the Longest day of 18 *hours* and 30 *minutes*; and this is called *Britannicum*, or *Germanicum*.

XXI. *The seventh* Suecicum. The *seventh* is, where the *Latitude* is of 70 *Degrees*, and the Longest day of 65 *Days*; and is commonly call'd *Suecicum*.

XXII. *The eighth*, Glaciale Boreum. The *eighth* is, where the *Latitude* is of 80 *Degrees*, and the Longest day of an 134 *Days*; and is called *Glaciale Boreum*.

XXIII. *The ninth*, Polare Boreum. *Lastly*, The *ninth* is that Space which is extended to the *Northern Pole*, where the Longest day is of *Half a year*, or of 188 *Days*, and is called *Polare Boreum*.

XXIV. *The first of the Southern Climats, is called* Brasilianum. The *first* of the *Southern Climats* begins at the *Æquator*, and ends in the 10*th Degree*, where the Longest day is of 12 *hours*, 35 *minutes*. It takes its name of *Brasilianum*, from the Country of *Brazile*.

XXV. *The second*, Peruanum. The *second* is, where the *Latitude* is of 20 *Degrees*, and the Longest day of 13 *hours* and 12 *minutes*: And is called *Peruanum*, from the Country of *Peru*.

XXVI. *The third*, Paraguaticum. The *third* is, where the *Latitude* is of 30 *Degrees*, and the Longest day of 13 *hours* and 56 *minutes*; and is called *Paraguaticum*.

XXVII. *The fourth*, Chiliacum. The *fourth* is called *Chiliacum*, from the Country of *Chili*, which is extended 40 *Degrees* towards the South; where the Longest day is of 14 *hours* and 51 *minutes*.

XXVIII. *The fifth*, Sylvestre. The *fifth* is, where the *Latitude* extends to 50 *Degrees*, and the Longest day is of 16 *hours* 9 *minutes*. It is called *Sylvestre*, because it is inhabited by *Savages* and *Wild People*.

XXIX. *The sixth*, Magellanicum. The *sixth* is call'd *Magellanicum*, where the Longest day is of 18 *hours* and 30 *minutes*, and reacheth to 60 *Degrees*.

XXX. *The seventh* Incognitum. The *seventh* is of 70 *Degrees*, and is call'd *Incognitum*, *Unknown*; where the Longest day is of 65 *Days*.

The

XXXI. *The eighth, Glaciale Auſtrinum.* The *eighth* is that, where the *Latitude* is of 80 *Degrees* and the Longeſt day makes 134 of our *Days*; and is called *Auſtrinum Glaciale.*

XXXII. *The ninth, Polare Auſtrinum.* The *ninth* and *laſt* is extended to 90 *Degrees*, where the Longeſt day is of 6 *Months*, and is called *Polare Auſtrinum.*

XXXIII. *Of Old there were only ſeven Climats, whereas now there are eighteen.* Formerly there were only 7 *Climes*, becauſe they contained all the Countries that were then known: But the *Earth* being more known and diſcover'd, is now diſtinguiſh'd into 18 *Climats*, which *Aſtronomers* call by another name, *Elevations of the Pole*; and *Geographers*, the *Latitudes of Places*, or their *Diſtances* from the *Æquator.*

CHAP. VII.

Of thoſe things which are generated in the Earth; and firſt of Fountains.

I. *Fountains and Rivers have their Riſe from the Sea.* FOraſmuch as *Fountains* break forth on the *Surface* of the *Earth*, and proceed from its *Bowels*, we muſt enquire in the *firſt* place, what is the Original of *Fountains*, and from what *Principle* they are derived. And this we find can be nothing elſe but the *Sea*: For ſeeing that many *Fountains* flow continually, and that the *Rivers* which are made by them, do without ceaſing continue their *Courſe* towards the *Sea*, without ever increaſing the ſame, according to that of the Wiſe *King* in the 1*ſt* of *Eccleſiaſtes*: *All the Rivers run into the Sea, yet the Sea is not full; unto the place from whence the Rivers come, thither they return to flow again.* And accordingly we may eaſily gather, that the Original of *Fountains* is from this, That the *Sea-Water* being driven into the *Bowels* of the *Earth*, is led up to the *Surface* thereof; where breaking forth, it at laſt, after various Turnings and windings, returns to the *Sea.*

II. *They return to the Sea, from whence they came.* And indeed, foraſmuch as the *Earth* contains many *Clefts*, by which, as by ſo many *Channels*, the *Water* may be carried from one place to another; there is no reaſon to oppoſe, but that *Water* may come from the *Sea*, to the bottoms of *Mountains*; and that the ſame which break forth in *Springs* from thoſe *Mountains*, may after various windings run again into the *Sea.* Much after the ſame manner, as we find that in *Living Creatures* the *Blood* is carried from the *Left Ventricle* of the *Heart*, through the *Aorta* into the *Arteries* and *Veins*, and after having finiſh'd its *Circulation*, returns to the *Vena Cava*, and from thence to the *Heart*, from whence it came forth at firſt.

III. *How the Water riſeth from the Sea to the Tops of Mountains.* But foraſmuch as the *Surface* of the *Earth* is not even, ſome part of it being ſtretch'd out into *Plains* and *Levels*, and others riſing into *Mountains*, which do far exceed in height the *Surface* of the *Ocean*; we are to enquire, by what means the *Water* becomes raiſed from the *Depths* of the *Earth*, to the *Tops* of the higheſt *Mountains*; as alſo how the *Sea-Water* becomes deprived of all its Saltneſs, when it breaks forth into *Springs* and *Fountains* whoſe *Waters* are freſh.

IV. *Not by the Suction or Attraction of the Earth.* As to the firſt of theſe, ſome are of Opinion that this is performed by the *Earth*, to which they attribute a Virtue of ſucking and attracting the *Water* to the tops of the *Mountains*: After the ſame manner as *Bread* being dip'd in *Wine*, doth ſuck and draw up the *Wine* into it ſelf; or as a *Sponge*, ſucks-up *Water.* But this way of explaining this Difficulty is not Rational, ſince *Sucking* preſuppoſeth a ſenſible Motion in the *Body* that *ſucks*; for I cannot *ſuck* without ſome dilatation and ſwelling of my *Body*: Neither can it be ſuppos'd that the *Earth* can perform any ſuch action. And as to the Inſtance of *Bread*, or a *Sponge* dip'd in *Water*, nothing can be inferr'd thence to prove, that the *Earth* ſucks up the *Water* to the tops of the *Mountains*; ſeeing that it is but a ſmall quantity of *Water* that is ſuck'd-in by the *Spongious Body*; and that that which is attracted by it, doth never run out from it. And ſo likewiſe may that part of the *Earth*, which lies next to the *Spring*, be moiſtned and ſoak'd through with the *Water* of it; but this will never make the *Water* ſpring or break forth from thence.

V. *Nor by the preſſure of the Sea-Water.* Others ſuppoſe, that the *Sea-Water* is raiſed to the higheſt parts of the *Earth*, by means of that preſſure whereby the *ſurface* and upper-part of the *Sea-Water* preſſeth that which is at the Bottom, and forceth it up the paſſages of the *Earth*, till having at laſt found an Out-let, it breaks forth on the *Surface* thereof. But neither can this *Opinion* be admitted; for tho' the *Water* at the bottom of the *Sea*, be driven into the *Cavities* and open Paſſages of the *Earth*, by the weight of the *Water* that lies upon it; yet can it not by this means be raiſed higher than the *Surface* of the *Sea.* Beſides, if the *Water* by ſome *Channels*, or wide and open *Paſſages*, ſhould be conveyed by one continued *Channel*, from the *Sea* to the *Surface* of the *Earth*, then it would not be *freſh*, but *ſalt*; becauſe the *Salt* eaſily gets through thoſe places, where the *Water* in any quantity can paſs; and ſo all *Springs* would be as *ſalt*, as the *Sea* it ſelf.

VI. *The Sea-Water being turned into Vapours, mounts upwards.* We ſuppoſe therefore, that the *Water* in thoſe *Holes* and *Caves*, whither it is driven by its weight, is reſolved into *Vapours* by the *Subterranean heat*; and that this *Heat*, by thoſe Paſſages which it every where meets with, mounts it upwards, and raiſes it to the *tops* of the *Mountains.* To which may be added, that the *Pores* through which the *Vapours* tend upwards, are continued open towards the very tops of the *Mountains*, and that they more eaſily mount up through the ſaid *Pores*, becauſe they are ſupported by the *Particles* of *Earth*, than through the *Air*, whoſe *fluid* and ſoft *particles*, cannot ſo uphold them and aſſiſt their Elevation. Now that there are ſuch *Subterraneous Fires*, that turn the *Water* into *Vapours*, is evident from thoſe *Fire-Vomiting-Mountains*, *Hecla*, *Veſuvius*, *Ætna*, and others of the ſame nature. And tho' ſuch *Fires* do not break forth from all parts of the *Earth*; yet it is probable that they communicate their *Heat* far and near, by means of *hollow Paſſages* in the *Earth*, in the ſame manner as the inborn *Heat* is diſperſed through the *Guts* and other parts of the *Body.*

VII *Condenſed Vapours furniſh the Fountains with Water.* But when the *Vapours* are thus mounted up, and are come near the *ſurface* of the *Earth*, they then become condenſed by meeting with the *Cold parts* of the *Earth*; and by this means being unable to mount higher, they cling together, and are turn'd to drops of *Water*: And ſince in this ſtate they are not able to return back by the ſame *Paſſages*, or *Pores*, becauſe of their Narrowneſs, they are carried downwards by their own *weight*; where

where many of them being united together make a *Subterraneous Rivulet*; and many of these *Rivulets* gather'd together make a greater, which breaking forth out of the *Earth*, constitutes a Living *Fountain* or *Spring*. An Example whereof we have in *Chymical Distillations*; where, by the means of *Fire*, many *Vapours* are driven up the *Alembick* from moist *Bodies*, which are condensed in the cool Head of the *Still*, and being united into Drops, run down the *Neb* thereof.

VIII. *What Springs or Fountains are.* So that *Springs* are nothing else, but *Sea-Water*, which being by its own weight driven to the bottom of *Mountains*, is there changed into *Vapours* by the inward *heat* of the *Earth*, and again condensed into *VVater* by the Coldness of the *Air*, or that of the tops of *Mountains*; whence these run down, according to the declining of the *Passages* that convey them, to the open place they have made for themselves on the side, or at the foot of the *Mountains*.

IX. *Why some Springs are dried up in Summer.* Some, it may be, will object: If it be true that *Springs* have their Rise from the *Sea*, whose *VVaters* being resolv'd into *Vapours*, by means of *heat* are again changed into *VVater*; how comes it to pass that some *Springs* are altogether dried up in *Summer* time, and do quite vanish by extream *heat*, since it cannot be question'd, but at that time many *Vapours* mount up from *Subterraneous places*, and that likewise there is *Cold* enough about the *surface* of the *Earth* to condense them.

X. *Answer.* I Answer, That these *Springs* which are subject to dry up in *Summer*, do for the most part owe their Original to *Rain* and *Snow*, which running through the *Clefts* of *Rocks*, do afterwards insinuate themselves through the *Pores* of the *Earth*, and drop down into some *hollow places*, and being there resolv'd into *Vapours*, by the *Heat* lodg'd in the *Bowels* of the *Earth*, meet with some proper place, by the *Coldness* whereof they become condensed, and so discharge themselves through some open passages on the *surface* of the *Earth*. Hence it is, that after long continued *Rains* we see many *New Springs* arise, which afterwards by degrees vanish, except more *Showers* succeed and fill those hollow places of the *Earth* from whence they proceeded, and supply Matter for a new breaking forth of *VVater*.

XI. *Of the various kinds of Fountains.* Whence we may distinguish *Fountains* into several kinds, according to their different ways of *Flowing*, *Failing*, or *Duration*; and so *Springs* or *Fountains*, are either Temporal or Perpetual: *Temporal*, are those that do not run continually: *Perpetual* are such as *spring* without ceasing. Which are again divided into *clear* and *pure Fountains*, falling down by drops, or gushing out with a *stream*; or *mixed*, being such as are impregnated with *Salt*, *Sulphur*, *Bitumen*, or *Jews Lime*, and the like.

XII. *How Wells come to be generated in the Bowels of the Earth.* *VVells* are furnish'd with *VVater* much after the same manner as *Springs* are: For after that the *Vapours* of *VVater* have been raised to the *surface* of the *Earth*, they are by the *Coldness* thereof changed into *VVater*; which afterwards wandring under *Plains* and *Mountains*, without being able to mount up to the *surface* of the *Earth*, are there turn'd into *VVells*. Now the reason why *VVell-water* doth not ascend higher, is, because *VVater* cannot mount up above the place of its first Rise, for being come up to that pitch, it is equally pois'd, and so can rise no higher. Another Reason also may be, because *VVells*, for the most part borrow their *VVaters* from *Rivers*, *Lakes*, and *Pools*, not far off: Or if they receive their *VVaters* from the *Sea*, the said *VVaters* being drained through the *Earth*, run together into one and the same place.

XIII. *Why Spring and Well-water is fresh.* Hence it is that *Springs* and *Wells*, tho' they proceed from the *Sea*, yet their *Waters* are fresh, whereas the *Sea-water* is *salt*. The Reason whereof is this, because the *Sea-water*, consisting of *fresh* and *salt Particles*, whereof the fresh only are turned into *Vapours*, and carried upwards, leaving the *salt particles* behind, it is plain that their *Water* must be *fresh*. For the *salt Particles*, being stiff and inflexible, can neither be changed into *Vapours*, nor pass through the winding and bending *pores* of the *Earth*. The *Water* therefore of *Wells* and *Fountains* is *fresh*, because the *Sea water* being drain'd through much *Sand* or *Earth*, is depriv'd of its stiff *saline Particles*, and so becomes *fresh*.

XIV. *How it comes to pass, that Salt water is found in some Wells.* If any Man enquire how it comes to pass, since only *fresh Water* is drained through the *Earth*, that notwithstanding much *Salt* should be found in some *Wells*, at a great distance from the *Sea*.

XV. *The Answer.* I Answer, That this may happen, because the *Passages* of the *Earth* in some places are more wide and open, through which the *Sea-water* passing freely, may reach those *Wells*, without leaving its *Saline particles* behind it: Or, because the *surface* of the *Sea* may lye level with the bottom of those *Wells*; or likewise, because where the ways are wide and open, the *particles* of *Salt* are carried upwards by the *particles* of *Fresh water*. Of which this is a confirmation, because in some *Mountains* are found vast lumps of *Salt* grown together like great *Stones*: For the *Sea-water* being got up thither, whilst the *particles* of *Fresh-water* mount still higher, the *Salt* is left alone in those *Cavities* it meets with there, and fills them up.

XVI. *Of Fountains that Ebb and Flow.* Some *Fountains* are famous for their *ebbing* and *flowing*, like the *Sea*; yet not all in the same manner. For there is one at *Cadiz*, and another at *Bourdeaux*, that imitate the *motion* of the *Sea*, and *ebb* and *flow* at the same time with it. There is another in *Spain* which *ebbs* when it is *flood* at *Sea*, and *flows* when there is an *Ebb-tide* at *Sea*.

XVII. *The Cause of these ebbing and flowing Fountains, is the Sea.* The Cause of this *ebbing* and *flowing* in *Fountains* cannot be attributed to any thing, but to the *Sea-tide*; by means whereof the *Sea* entring into some *Subterranean passages*, drives up the *Water* as high as it self riseth. But the Reason why these *Springs* variously imitate the *Sea-tide*, is to be deduc'd from the difference of the *passages* through which the *Water* is convey'd: For if these *Channels* be strait without windings, or if the distance from the *Sea* be small, the *Fountain flows* at the same time with the *Sea*, and falls again when the *Sea ebbs*. But if the *Water* be convey'd to the *Cavities* of *Fountains*, through many crooked and winding *passages*, it may so happen that the *Fountain* may not *swell* when the *Sea flows*, nor fall when it *ebbs*; but quite contrary may *swell* when it *ebbs*, and sink when the *Sea flows*; because the *Water* having so many winding *passages* to go through, much time is thereby lost, so that by that time the *water* of the *Fountains* begins to *swell*, the *Sea* begins to *ebb*.

CHAP. VIII.

Of Metals and Minerals.

I. *What Metals are.* METals *are Bodies dug out of the Earth, Heavy, Hard, and Fusible by Fire, hid in the Inward part of the Earth, and there generated by the heat of the Sun, and subterraneous Fires.* Such as are *Gold, Silver, Copper, Iron, Tin,* and *Lead.*

II. *Of what Parts the Metals are compounded.* The *Particles* which compose *Metals*, are *Salt, Oil,* and *Earth*; which being mingled together, and meeting in the long and branch-like *Pores* of the inward parts of the *Earth*, are in the same so straitly link'd together, that *Art* hath not as yet found out any means whereby to separate them.

III. *Which be the pure Metals.* Some of these are called *Pure Metals*, others *Impure: Pure Metals* are those, *which compar'd with others, have been excocted or digested to a greater degree of fineness and perfection*, by means of the *Solar* and *subterraneous Heat*; such as are *Gold* and *Silver*. *Gold is the most heavy and most perfect of all Metals, very ductil, consisting of parts of equal Fineness and Heaviness, and being more heavy than the particles of Fire, cannot be carried away by them:* Which is the Reason why *Gold*, when it is *melted*, loseth nothing of its *weight*, as having no *Dross*, which by the Action of the *Fire* might be separated from it. *Silver is a Metal in Fineness and Perfection inferiour to Gold, heavy and solid, less ductil than Gold, and which being melted in the Fire, loseth something of its weight*; more especially that which by the agitation of the *Fire* is turned to *Dross*.

IV. *Which the Impure.* *Impure Metals*, are those *whose Principles are not so mature and refin'd, nor so fix'd and pure. Some of these, because of their impure Earthy substance, are made Red-hot before they can be melted*; as *Copper* and *Iron*: Whereas others of them, because of their abounding Moisture, are *melted* before they become *Red-hot*; as *Tin* and *Lead.*

V. *The Principles of the Chymists examined.* To the end that the *Nature*, not only of *Metals*, but of *Minerals* also, may be the more clearly and distinctly known, it will be fitting that we know before-hand, what we are to understand by the *Active Principles* of the *Chymists*; and what the *Philosophers* mean by *Salt, Sulphur,* and *Mercury.*

VI. *What we are to understand by the word* Salt. By the Name of SALT, we understand a *sharp Juice*, consisting of slender and stiff *particles*, which being intercepted in the *Pores* of the *inward* part of the *Earth*, are beaten or forged into *little Swords*: For as a *round Rod* of *Red-hot Iron*, is by the frequent stroaks of *Hammers* beaten into a longish *thin Plate*; so those *particles*, by being dash'd and rubbing against the hard Sides of the *Pores* of the *Earth*, are form'd into such *Figures.* Wherefore *Salt* is nothing else, but a *sharp Juice, consisting of slender, stiff and sharp Particles.* Which, if it be *volatil* and very bitter, is called *Salt Armoniack*; if it be more fat and inflammable, growing to *Walls* and *Rocks*, 'tis called *Nitre* and *Saltpeter*; if it be found in *Mines* and *Mineral-waters*, *Allom*; if it be joyn'd with a *Metallick matter*, and a most sharp and subtil *Mercurial Juice*, 'tis called *Vitriol.*

VII. *What Sulphur is.* By SULPHUR we understand, the very soft amd minute *Branchy particles* of *Fat* and *Oily matter.* And that such *particles* abound in *Brimstone*, we can demonstrate by this that it is very *inflammable*; for it is evident, that *soft* and *thin particles*, are the first of all others put in *motion*, and snatch'd away by the *Fire.* *Sulphur* therefore *is a Mineral Juice, consisting of the most soft and minute Branch-like particles of Fat and Oleaginous Matter, easily inflammable, and generated in the Caverns of the Earth.*

VIII. *What Mercury is.* By the Name of MERCURY we understand *Quicksilver*, or an *opake* and ponderous *Liquor*, consisting of thick, slippery and smooth *particles*; whose Nature shall be explained hereafter.

IX. *The number of Metals.* *Metals* are commonly reduced to six *species*, as was before mention'd, *viz. Gold, Silver, Copper, Iron, Tin* and *Lead.* To which some joyn *Mercury* or *Quicksilver*, which tho' it be *liquid* in its Natural state, and *Proteus*-like changeth it self into all *forms*; yet may it be made solid, and that several ways; as when it is held over the Fumes of *Molten-Lead, &c.* The *Astrologers* seem to favour this Opinion, *viz.* That *Quicksilver* is a *Metal*, who, as they appropriate *Gold* to the *Sun*; *Silver* to the *Moon*; *Iron* to *Mars*; *Copper* to *Venus*; *Tin* to *Jupiter*; and *Lead* to *Saturn*; so they attribute *Quicksilver* to *Mercury*, and do own its Virtue to be derived from the Influences of that *Planet.*

X. *The various Juices that are in the Bowels of the Earth.* To the end we may more clearly discover the Original of *Metals*, it will be of use to suppose, that in the Inward part of the *Earth* there are certain *fluid Bodies*, whose *particles* do not stick so close together, but that they may be easily dissolved: Such as are some *Earthy Juices*, which being generated in the deepest *Bowels* of the *Earth*, and consisting of the thickest *particles* of the upper part thereof, do fall down thicker by the force of the *Globuli* of the *second Element*, which by pressing them makes them heavy, and by passing through the *Pores*, wherewith they abound, somewhat agitates and makes them less, and so reduceth them to two kinds of *Figures.* For the *Particles* whose Matter is more solid, as those of *Salt* are, being intercepted, and, as it were, hammer'd in those *Pores*, of *round* and *stiff*, are made *plain* and *flexible*: Much after the same manner, as we have said, that a *Rod* of *Red-hot Iron* is hammer'd into a thin *longish plate.* And forasmuch as these *particles*, being agitated by the force of *Heat*, do this way and that way creep through these *pores*, by dashing and rubbing against their *hard Sides*, they become sharp like so many *little Swords*, which then constitute *sharp, sourish*, and *corroding Juices.* But the more *soft particles*, as are those of *Fresh-water*, and the like, being in the said *pores* wholly crush'd and bruised, are reduced to so great a thinness, that by the Motion of the *first Element*, they are divided into many very small and extreamly flexible little *Boughs*, which lying upon one another, are moved by a slow and creeping *motion.*

XI. *Metals are formed in the inward parts of the Earth.* Forasmuch therefore as *Metals* are solid and heavy *Bodies*, it is evident that they cannot consist of the outward *Crust* of the *Earth*, which is *softer* than the other parts. For tho' the uppermost part of the *Earth* consists of *Ramous* or *Branchy parts*, which

which are firmly joyn'd together; yet becauſe there are many Intervals between them, which may be taken up by the *Air*, or other *Bodies*, and by their agitation are an obſtacle to Solidity, which is the Property of *Metalline Particles*, it is neceſſary that they ſhould be generated in the more *inward parts* of the *Earth*, which are more cloſe, hard and compact. So that it ſeems probable that theſe *Metals* are hid, and cannot be reached or come to, by reaſon of the Depth of the *Earth*, and the ſtore of *Water* that is about them, which thoſe that go to ſearch for them cannot fail to meet with.

XII. *How the Particles of Metals are conveyed to the outward part of the Earth.*

But ſeeing, that beſides the *Vapours* which exhale from the *Waters* that lye hid under the *Earth*, there are alſo many *ſharp Spirits*, and *oily Exhalations*; and likewiſe *Vapours* of *Quickſilver*, which can carry along with them, from the inward part of the *Earth*, the *particles* of other *Metals*, and with them aſcend to the outſide of the *Earth*; by this means theſe *Metalline Particles* being brought to the *ſurface* of the *Earth*, do there ſtop between the *Sand*, and conſtitute *Veins* of ſeveral *Metals*. For it is probable, that the Reaſon why any *Metals* come within our reach is, becauſe the foreſaid *ſharp Juices* flowing through the paſſages of the *inward parts* of the *Earth*, do ſeparate ſome of its *particles* from their fellows, which being wrapt up in ſome oily Matter, are afterwards eaſily carried upwards by *Quickſilver* rarified by *Heat*, where they conſtitute ſeveral *Metals*, according to the diverſity of their *magnitudes* and *figures*.

XIII. *The diſtinction and diverſity of Metals, depends on the difference of their Parts.*

For nothing elſe is required to the Diſtinction of *Metals*, than the changing of their *parts*, or a different ranging of them: Becauſe *Bodily things*, whoſe *parts* are of the ſame bigneſs, and alike *ranged*, are to be accounted the very ſame things; their diſtinction only proceeding from the various *contexture* of their Parts, as when by the acceſſion of new Parts others are thruſt out of their places, or they become otherwiſe ranged. And thus thoſe *particles* that have *long* and *round*, as alſo *ſmooth* and *ſlippery Figures*, which becauſe of their *weight* lye one above another, and are moved only by the Matter of the *Firſt Element*, that fills up the Spaces between them, do conſtitute *Quickſilver*. For this is nothing elſe, but *a very heavy and opake Liquor, conſiſting of ſuch thick Particles as are long, and round like a Pillar, and very ſmooth, which tho' by reaſon of their weight they lye one upon the top of another, yet are eaſily moved by the Æthereal Matter that fills their Pores.* And ſo likewiſe thoſe Parts which are ſo firm and fix'd, as that they cannot be changed by any *Fire*, or conſum'd by any *acid Spirits*, conſtitute *Gold*. Thick and Branchy *Particles*, whoſe *ſurfaces* lye cloſe together, and whoſe *Pores* are only penetrated with the *ſtriate Matter*, make *Iron*. And ſo for the reſt of the *Metals*, which derive their diſtinction from the different *magnitude* and *figure* of their *Parts*.

XIV. *Tranſmutation of ſome Metals is poſſible.*

For this Reaſon ſome have believed the *Tranſmutation* of *Metals* to be poſſible, ſince it is notorious that *Iron* may eaſily be changed into *Copper*: For if *Iron* be caſt into *Copperas* or *Vitriolick Water*, its outſide is thereby turned Red, which *Red powder* being frequently ſcrap'd from it, and melted down, becomes true *Copper*. The ſame *Tranſmutation* is alſo effected by ſome *Fountains*; as by that which AGRICOLA mentions, near *Smolnitz*, the *Water* whereof being derived into three *Channels* rang'd in order, in which pieces of *Iron* are laid, they are thereby changed into *Copper*; and the ſmall *ſcales* of *Iron* are ſo corroded by this *Water*, as to become like *Clay* or *Dirt*: All which afterwards being melted down, becomes pure and good *Copper*. It is manifeſt alſo that *Quickſilver* may be chang'd into another *Metal*. For if after you have reduc'd *Lead*, or *Litharge*, to *Aſhes*, you pour the *Flegm* of *Vinegar* upon it, and afterwards pour ſome drops of this *Vinegar* upon *Quickſilver* diſſolv'd in *ſtrong Water*, it will preſently be precipitated to the bottom of the *Veſſel* in the form of a *Powder*, which being melted down becomes *Lead*.

XV. *It is morally impoſſible to make Gold.*

But the Queſtion is, Whether Imperfect *Metal*, by Example *Quickſilver*, can be turn'd into *Gold*? This the *Chymiſts* confidently aſſert, and take for their Vouchers, RAYMUND LULLY and ARNOLDUS *de Villa Nova*; who, they tell us could do as much. But I take all this to be no more than *Lies* and *Stories*: Or if ever they did make *Gold*, that this Effect was not to be attributed to their *Art*, but to meer Chance. And indeed it is a thing as unlikely, as if a *Man* having broke his *Hour-Glaſs*, ſhould ſo dexterouſly throw the *Sands* of it upon a *Table*, that the grains of it ſhould be ranged into the *figures* of ſuch Letters as ſhould make up ſome *Verſes* of *Ovid's Faſtorum*. For ſince we are ignorant of the preciſe *bigneſs* and *figure* of thoſe *Particles* that enter the Compoſition of *Gold*; as well as of the way of knitting them together, ſo as to make one *Body* of them; we may well conclude, that to make *Gold* is a thing morally impoſſible.

XVI. *Ductility is a Property of Metals.*

It is a Property of *Metals* to be *Ductil*, and more eſpecially of *Gold*, a ſmall quantity whereof may be beaten or drawn out into a vaſt extent. For out of one Broad piece of *Gold*, a vaſt number of *Leaves* may be beaten, 5 or 6 whereof are ſufficient to cover a piece of *Silver*, of a *Cylindrical Figure*; which being drawn into a fine Thred, the *Gold* is coextended with it, there being no part of the *Silver-thred* to be ſeen which is not gilt. The reaſon of this Ductility in *Metals* is, becauſe the *particles* of *Metals* are of a *Longiſh figure*, and are ſo diſpoſed, that they lye upon one another according to their whole *ſurface*; which makes, that when they are preſt under the *Hammer*, or in *Drawing*, they fall down ſideling, and joyn ſide to ſide without any ſeparation. Thus it comes to paſs, that *Metals* under the *Hammer*, may be extended into length and breadth, ſtill retaining the firm cohæſion of their *parts*; and the ſame is the Cauſe of their ductility into *Threds*.

XVII. *Metals are ſubject to Ruſt.*

Metals are ſubject to Corruption by *Ruſt*, and more eſpecially *Iron*. Which is an Argument, that its *particles* are not more ſolid than thoſe of other *Metals*, tho' they be Thicker; but that it abounds with *Pores*. And becauſe theſe *Pores* after Infuſion grow leſs, therefore it is that *Steel* is not ſo eaſily penetrated by other *Bodies*, as *Iron*, and conſequently, leſs ſubject to *Ruſt*. Now *Ruſt* is nothing elſe, but a perturbation of the Parts of *Metals*, cauſed by the Exhalations of a greatly agitated *Sulphureous Liquor*, the *particles* whereof thruſt themſelves into the *Pores* of *Metals*, and ſtop the *Orifices* of them.

The

XVIII. *The Sun is the Efficient Cauſe of Metals.* The Efficient Cauſe of all *Metals* is the *Sun*, whoſe *heat* pierceth through all the *Paſſages* and *Pores* of the *Earth*. For tho' the *Action* of *Light* be nothing elſe, but a kind of *Preſſion*, whereby the *Sun* puſheth the *ſubtil Matter* to *Right Lines*, that reach from his *Body* to the *Earth*; yet the *Terreſtrial particles* being agitated by his *heat*, do continue in their *motion*, except ſome intervening Cauſe do chance to hinder them. Hence it is we perceive, that the Heat which the *Light* hath left upon the *ſurface* of the *Earth*, doth continue for ſome time; ſo that it is no wonder, if from thence by degrees it proceeds to the *Bowels* of the *Earth*, becauſe the *Terreſtrial parts* that are ſtruck by the *Sun-beams*, do move thoſe that lye next to them, and they again their *Neighbours*, till the *Heat* at laſt be derived to the moſt Inmoſt parts of the *Earth*. After the ſame manner as a mans *Head* cover'd with a *Hat*, tho' it be not enlightned by the *Sun*, yet is ſenſible of its *heat*, even after that the *Sun-beams* do no more beat upon it. And thus much ſhall be ſufficient to have ſpoken of the *Nature* of *Metals*, their *Original* and *Affections*; we proceed now to the *Minerals*.

XIX. *What Minerals are.* MINERALS, are *Bodies made up of Salt, Sulphur and Mercury, mingled in a certain proportion with Aqueous and Terreſtrial particles, and excocted or brought to perfection by means of Subterraneous fires, or the Sun's heat, and digg'd out of the Mines of the Earth.* Wherefore alſo they are called *Foſſils*.

XX. *How many ſorts of Minerals there are.* There are Three kinds of *Minerals*: 1. *Mineral*, or *Coagulated Juices*: 2. *Mineral Earths*: 3. *Stones*.

XXI. *Mineral Juices.* *Coagulated Juices are Mineral Bodies, compounded of ſharp and oleaginous Juices, mingled with a more groſs Earthly Matter, endued with a ſtrong taſte or ſmell, and eaſily ſoluble in Water or Oil.* The chiefeſt of this kind are *Salt* and *Sulphur*.

XXII. *Mineral Earth.* *Mineral Earth, is a Body dug out of the Earth, conſiſting of Terreſtrial Particles, joyned with a tough and viſcous Humidity, reducible to Powder, and ſoluble in Water, ſo as thereby to be turn'd into a kind of Clay.* Wherein it differs from *Mineral Coagulated Juices*, which are wholly diſſolv'd in *Water*, and are not turn'd into *Clay* by admixtion of the *Aqueous particles*.

XXIII. *The various kinds of Mineral Earths.* Theſe *Mineral Earths* are *various*, according to the diverſity of the *Particles* whereof they conſiſt; or of the *Juice*, whereby their Parts are joyned together; as alſo of the *Country* where they are found. For if the *Matter* be very tough, ropy and unctuous, it makes *Potters-Clay*; if it be tough, white and dug up in the *Iſle* of *Crete*, it is *Chalk*; if in the *Iſle* of *Samos*, *Samian Earth*; if a yellow Colour, *Oker*; if Red, and found in the *Iſle* of *Lemnos*, *Lemnian Earth*, and *Sealed Earth*, becauſe it was uſed to be ſealed with the Seal of *Diana*'s *Prieſt*; if it be of a pale Red, and digg'd in *Armenia*, 'tis call'd *Armenian Earth*, or *Bole*. What *Stones* are, ſhall be delivered in the next *Chapter*.

XXIV. *In what part of the Earth Minerals are produced.* *Minerals* are not generated, like *Metals*, in the Inward parts of the *Earth*, where they have the whole weight of the *Earth* lying upon them; but about the *ſurface* of it, where its Parts are ſeparated by infinite *Chinks* and *Creviſſes*, by which they give a free paſſage to *Vapours* and *Exhalations*, and to other *particles* of that *Matter*, which the *Heat* contain'd in its *Bowels* hath put into *motion*. And foraſmuch as it is peculiar to *Exhalations*, to mingle themſelves with the ſmalleſt *particles* of the *Earth* they ſnatch along with them, they by this means come to form certain little *Lumps* or *Maſſes*, which after various agitation acquire alſo the ſame *motion*; but that ceaſing, they are all at laſt brought to a ſtate of *Reſt*, being cloathed with a roundiſh *Figure*. And after this manner 'tis probable that the *Grains* of *Sand* are formed; which are *Heavy*, becauſe they are compacted of *Terreſtrial Matter*; *Hard*, becauſe they are without *motion*; and *Tranſparent*, becauſe they have *Pores* that tranſmit the *Globuli* of the *ſecond Element* to right *Lines*, in the very ſame manner as they were moved, before that the *Particles* of *Sand* were yet *Coagulated*.

XXV. *The Pellucid Grains of Sand being heaped together, make an Opake Body.* Tho' every ſingle *grain* of *Sand* be tranſparent, nevertheleſs where many of them meet together, ſo as to make a *Heap*, they conſtitute an *opake Body*; becauſe in this ſtate they cannot give a free paſſage to the *Light*, ſeeing that each *ſurface* reflects ſome Rays of it. Thus the Powder of *Glaſs* is not Tranſparent, becauſe the various *particles* of *Glaſs* cannot have their *pores* ſo correſponding with one another, as freely to tranſmit the *Light*. Thus the *Grains* of *Sand*, eſpecially thoſe of the *Indies*, when beheld through a *Microſcope*, be tranſparent, and reſemble *Diamonds*; yet when they lye in heaps, they can no longer give free paſſage to the *Light*, and therefore conſtitute an *opake Body*.

XXVI. *How Potters Clay differs from Sand.* *Potters Clay*, notwithſtanding that it is *tough* and *fat*, yet is produc'd much after the ſame manner as *Sand*; only with this difference, that the *Grains* of *Clay* are much leſs, which make their *Intervals* not to let in *water* ſo readily, nor indeed without ſome force.

XXVII. *The reaſon of the difference of Clay in ſeveral parts.* If the *Particles* of *Salt* and *Oil*, which continually aſcend from the Inward parts of the *Earth*, were always like one another, we ſhould every where meet with the ſame kind of *Sand* and *Clay*: But it being very probable, that the ſaid *Particles* of *Salt* and *Oil*, are not in all places the ſame; it is to be of no matter of Wonder to us, that the *Clay* and *Sand* likewiſe is not always the ſame, but differing in Colour and the Magnitude of their Parts.

CHAP. IX.

Of the Generation of Stones, Common and Precious, and of their difference and diſtinction.

I. *What Common Stones are.* STONES are *Mineral Bodies*, hard, and compounded of a *petrifying Juice*, and *Terreſtrial Particles*, not ſubject to *Fuſion*, but *Calcination* by *Fire*; nor malleable, but breaking to pieces under the ſtroak of the *Hammer*. Theſe, according to the Purity or Impurity of the *Matter* whereof they conſiſt, are divided into *Common* and *Precious*, which are either generated in the *Bowels* of *Animals*, or without them.

Some

II. *New Stones are daily generated in the Earth.*

Some are of Opinion, that there are no *New Stones* produced, but that all of them were created at the Beginning. But *Miners* assure us to the contrary, who often find *Stones* in those places, where before was nothing but *Sand* or *Clay*. Whence it is obvious to conclude, that both these are the *matter* of *Stones*, and that of the *particles* thereof variously joyned and mingled together, they are compounded. For tho' things made of *Sand* be hard, and cannot be softned; yet this nothing hinders, but that by the help of some *Terrestrial matter*, filling their *Pores* and *Intervals*, they may so hang together, as to constitute *Stones*. Thus it frequently happens, that *Waters* running through the *Earth*, do carry away with them some small *particles* of the *Stones* through which they run; which *water* coming afterwards to places where its Current is very slow, may give occasion to those *particles* to unite together, and constitute a *Stone*.

III. *A twofold Rise of Stones.*

Stones may be made of *Sand* these two ways; first, out of *dissolved Sand*, as when *Sand* dissolved in any quantity, is afterwards hardned. And the *Stones* thus formed are transparent, as the single *grains* of *Sand* are, and are of various *figures*, according to the Compression of the *Bodies* that are lying about them. The other way is, when *Stones* are made of *solid Sand*; as when a great heap of *grains* of *Sand*, by the intervening of some *Exhalation*, do grow together: This way all *opake* and *rough Stones* are made, which are proper for the grinding of *Iron*, and polishing of other *Stones*.

IV. *That there is such a Matter wherewith the parts of Stones are knit together.*

It is not to be doubted, but that much of this Matter is sublimed towards the *surface* of the *Earth*, in the form of such *Exhalations* as accompany the rising *Vapours*. This is evident in many *Fountains*, which notwithstanding that the *water* of them being very clear to the *Eye*, yet contains great store of them, which meeting and joyning together in some Parts, become sensible. Thus there is a *River* in *Avergne* in *France*, which doth so abound with these *Exhalations*, that the Channel of it is become *Stony*, swelling by degrees higher and higher. In like manner there are found some *Springs* which cover the *Channels* and Conveyances by which they pass, with a Crust of *Sand-stone*. And there is one at *Rome*, which stopt the *Pipe*, through which its *water* passed, with *Alabaster*.

V. *How Marble is formed.*

The *production* of *Marble* doth not at all differ from the *production* of other *Common Stones*; save only that the *Clay* whereof it is made consists of lesser *particles*, and hath straiter *Pores*, which for that Reason are more easily fill'd with those *Exhalations* that stick to the Sides of them. And this makes the Composition of *Marble* more acurate, and the Texture of its *parts* more close and compact, than the common *mixture* of *Stones* is. Which may be easily gather'd from the smoothness of its *surface*, seeing that the Roughness of *Sand-stones* and *Pumice-stones*, and other such like, proceeds only from their *Cavities*. Now *Marble* is polish'd with *Sand*, by the rubbing whereof its prominent *particles* are worn away. In this Polishing, *Water* also is made use of; which being mix'd with the *Sand*, doth by this means more easily insinuate it self into the *pores* of these *Particles*, that are to be rubb'd off. There are several sorts of *Marble*, some being *White*, others *Black*, some *Transparent*, and some *Opake*; all which diversity proceeds from the various Contexture of their *Parts*.

VI. *Some Stones are Diaphanous, others Opake.*

For *Transparent Stones* are generated, when the *Exhalations* and *Vapours* being first changed into *Juices*, in the Chinks or Cavities of the *Earth*; afterwards by the departure of those *fluid Particles*, do come nearer together, and by degrees so cleave together, that the *Globuli* of the second *Element* have free passage through their *pores*, in order to the Transmission of the *Action* of *Light*. And on the contrary *Stones* become *Opake*, when the *Vapours* that are shut up in the narrow Chinks and Clefts of the *Earth*, are there stopt, and become so mingled with the *Earthy particles*, that the *pores*, in many places, are not wide and open enough to transmit the *Light*.

VII. *Several kinds of Common Stones.*

There are many kinds of *Common Stones*, viz. *Marble*, *Flint*, *Touch-stone*, *Whet-stone*, *Pumice*, and *Sand-stone*; *Stones* in the *Bladder* or *Reins*; *Talck*, *Load-stone*, *&c.* Of *Marble* we have treated already.

VIII. *Flint.*

Flint is almost the hardest of all *Stones*, and is commonly Round, and somewhat Flat, like *Lentiles*, and being dash'd against another, divides it self in two little *Hemispheres*. Because of its extream *hardness* it is apt to leap back or rebound, since it neither yields, nor can be easily reduc'd to Powder. Its *production* is much like that of *Marble*, being found buried in *Clay*, as in its *Matrix*, whose *pores* being fill'd with the said *Exhalations*, procure it the great Hardness it hath.

IX. *Touch-stone.*

Touch-stone belongs either to *Marble* or *Flint*. It admits of the most perfect Polishing, and is sometimes found very exquisitely smooth'd by *Nature*. For which Reason also it is very *hard*, and doth not admit any Division without difficulty.

X. *Whet-stone.*

A *Whet-stone* has a Roughness, which conduceth to the Smoothing and Grinding of *Glass* and *Metal*; in which Operation *Water* is sprinckled upon it: For the *Water* being pour'd over it, smooths and makes even the more sensible Asperities of the *Whet-stone*, and hinders it from acting too boisterously upon the *Body* that is to be Ground.

XI. *Pumice-stone.*

Pumice-stone is a *Stone* of an *Ash colour*, full of great Cavities like a *Sponge*, into which it admits Moisture, but soon lets it go again. It is made use of for the Polishing of *Marble*; for by its Roughness it reduceth the prominent parts of *Marble* to smoothness.

XII. *Sand, or Gravel-stone.*

The *Sand-stone* is formed in *Holes*, from whence the intercepted Matter derives its *smoothness*. Its Colour is *white*; because its *particles* are so dispos'd, as to reflect or send back the *Rays* of *Light*, in the same manner as it hath received them. Wherefore also it appears in the likeness of *Froth*. Tho' it be very Light, yet doth it not swim upon the *Water*; but the *moisture* entring into its *pores*, it sinks immediately.

XIII. *Talck.*

Talck is a *Stone* that is *Transparent*, except it be too thick; for then it is *opake*, by reason of the multiplicity of *Surfaces* heap'd one upon the top of another, and whose *pores* do not correspond exactly enough for the *Transmission* of *Light*.

XIV. *Stones form'd in the Body of Man.*

A *Stone in the Body of Man*, is formed in like manner as other *Stones* are, *viz.* by the *Coalition* of *Sand*, by means of some *slimy Matter* in the *Reins* or *Bladder*. It commonly inclines to a *reddish Colour*, and according to the different disposition of the *Sand*, is either *smooth* or *rough*; as we see that *Stones* that lye at the bottom of *Rivers*, are some of them *smooth*, and others very *rough* and *uneven*.

XV. *What precious Stones are.*

Precious Stones, are Bodies small in bulk, of a hard and strong substance; which either are Transparent, or of a lustrous Colour.

XVI. *How precious Stones are generated in the Earth; and first of such as are transparent.*

Gems are generated, not of a company of *Sands* grown together, as the *Common Stones* are; but of a certain *fluid Matter*, which only constitutes one *grain*; provided there be but so much of it, as to make some sensible Bulk, and such as is sufficient for a *pellucid Body*. Because that when the *Exhalations* that in the Clefts and Cavities of the *Earth* are gather'd into a *Drop*, by the loss of their slippery and fluid *Particles*, begin by little and little to cleave to one another, the *Globuli* of the *second Element* can on all sides freely and strongly enough pass through their *pores*; which could not be, in case they did consist of many *grains*: For how soft soever they might afterwards come to be, yet they could never be so joyned, but that there would be some *Interruption*, which would spoil their *Transparence*. And therefore these kind of *Exhalations*, according to the different degrees of their *Hardness*, and the various disposition of their Parts, are turned into *Stones*; as into *Crystal*, *Diamonds*, and the like. There is no difference betwixt a *Crystal* and a *Diamond*, save only that the *particles* of a *Diamond* are more closely knit together.

XVII. *Of Colour'd Gems.*

But if it so happen, that any *Metalline particles* be mix'd with this *matter*, that is common to all *precious Stones*; this causeth some modification of the *Light* that passeth through them, so that it produceth in us the *sense* of divers *Colours*; and thus instead of a *Diamond* or *Crystal*, we shall have several kinds of *precious Stones*, as *Saphirs*, *Chrysolits*, *Jaspars*, *Agats*, and the like.

XVIII. *The several kinds of Precious Stones.*

Precious Stones therefore are divided into *Transparent* and *Colour'd*. The *transparent* are *Crystal*, the *Diamond*, and the *Beryl*, which have their Parts so ranged, as to leave Intervals, through which the *Globuli* may transmit their *Action* to *Right Lines*. The most *precious* of these is the *Adamant*, being of an exceeding Hardness, because of the close coherence of its Parts. Yet is not its Hardness such, as to be of proof against the *stroaks* of a *Hammer*, as some relate, seeing that it may be grinded into Powder. So likewise the Common Story of its becoming soft in the *Blood* of a *Goat*, is no better than a *Fable*; and that it cannot be hurt by the *Fire*: All which Experience hath condemn'd of *falsity*.

XIX. *Crystal.*

Crystal is of an *Hexagonal figure*; for every *particle* of *Crystal* being surrounded and kept in by six others, it must necessarily admit of a six Corner'd *figure*. There are some that affirm, That *Crystal* by the strength of the *Fire* can be melted; whereas others assert the contrary, and that after utter Diligence used, they could never bring it to *Liquefaction*. Some of the *Ancients* believ'd, that *Crystal* was the effect of extream *Cold*; but this is a vain Imagination, for all confessing *Crystal* to be a *Stone*, we cannot attribute its *Coagulation* to *Cold*. *DIODORUS* was better advis'd, who *Lib.* II. tells us, that *Crystal is a Stone coagulated out of pure Water, not by Cold, but by the virtue of a Divine Fire.*

XX. *The Beryl.*

The *Beryl* hath a great resemblance with *Crystal*; it is chiefly found in the *East Indies*, according to *PLINY*, at least the best and most lustrous are found there. For those we have from *Babylon* are of a kind of *greasy Colour*; yea, it is said, that there are *Beryls* found in *Germany* of the Colour of *Oil*.

XXI. *The Carbuncle.*

The most Noble of all the *Colour'd precious Stones* is the *Carbuncle*, of a *Red colour*, and resembling the *flame* of *Fire*.

XXII. *The Chrysolite.*

The *Chrysolite* is a *Gem* of a *Golden colour*, whence it took its Name; transparent and very hard.

XXIII. *The Hyacinth.*

The *Hyacinth* is of a *Yellow colour*, resembling the *lustre* of *Gold*.

XXIV. *The Emerald.*

The *Emerald* is the most *precious* of all *Gems*, and well nigh the most *Brittle* too, for it is easily broken. It is of a *Green colour*, like *Grass*.

XXV. *The Topaz.*

The *Topaz* approacheth to the Colour of an *Hyacinth*; tho' some do say it is of a *Green colour*. It is said, that when it is laid under the *Sun-beams* it represents a *Star*; which is rather the effect of its *form* and *colour*, than of any *peculiar Nature*.

XXVI. *The Turcois.*

The *Turcois* is a *precious Stone*, of a *Sky colour* mixt with *Green*.

XXVII. *The Amethyst.*

The *Amethyst* is much of the same *softness* as *Crystal*, and is found in the same place. It is of a *Violet Purple colour*, very grateful to the sight.

XXVIII. *Morion.*

The Gem *Morion*, is of a very *Black colour*.

XXIX. *The Agate.*

The *Agate* admits of all *Colours*, as having *white*, *black*, and other variegated *stroaks* in the midst of it. And by this diversity of its *colours*, it is represented of divers *kinds*, by those who have a mind to deceive the *Buyers*.

XXX. *The Jasper.*

The *Jasper* is a *Green stone*, with the mixture of *Bloody spots*. The best are those that come from the *East*.

XXXI. *The Ruby.*

The *Ruby* takes its names from the glorious *Red colour* wherewith it sparkles.

XXXII. *The Granat.*

The *Granat* is also of a *Red colour*, but with some mixture of a *Yellow*; so called, because of its likeness to the grain of a *Pomgranate*.

XXXIII. *The Onyx.*

The *Onyx* is the *Alabaster* of the Ancients, but much more *precious* than that which we commonly call so; it resembles the *colour* of the *Nail* of a a *Mans Hand*, with some Veins running through it, which imitate the colour of a *Jasper*.

XXXIV. *The Saphire*

The *Saphire* exceeds the other *Gems* in Beauty, and is of a *Sky Blew colour*, resembling the lively colour of the *Sky*, by its wonderful lustre, and extraordinary perspicuity. It is the hardest of all *precious Stones*, next to the *Diamond*.

XXXV. *Of other Stones that are counted amongst the Precious, but are not so.*

There are also other *Stones* which are reckoned amongst the *Precious*, as the *Pezar*, or *Bezoar*, *Pearls*, *Chelidonius* or the *Swallow-Stone*, *&c.* But these do not seem to deserve the name of *Gems*; because the *Pezar*, which is found in the *Stomach* of a Beast called *Pezain*, is too soft to deserve that name. *Pearls* which are found in the *shells* of *Oysters* and *Muscles* are of too dark and faint a *colour*, and without *transparence*. And the *Swallow-stone*, which is found in the *Stomach* of *Swallows*, hath nothing in the least in it that resembles a *Gem*.

CHAP.

CHAP. X.

Of the Load-Stone, and Electrical Bodies.

I. *Of the Original and Compoſition of the Load-ſtone, and what its Nature is.*

THo' the *Load-ſtone* be reckon'd amongſt *Common Stones*, yet doth not the *Earth* produce any thing more wonderful than it, the effects whereof, as they were matter of Aſtoniſhment to the *Ancients*, ſo do they ſtill puzzle the *Brains* of the *Greateſt Philoſophers*. This wonderful *Stone* is compounded of thick and branchy *Particles* of the *Earth*, approaching to the Nature of *Iron*; ſince there is no *Iron* Oar, which hath not much *Earthy matter* joyn'd with it; nor any *Load-ſtone*, which doth not encloſe more or leſs of *Iron*. Yea, ſo great is the affinity between the *Load-ſtone* and *Iron*, that they are both digged out of the ſame *Mines*; and if we will take the word of *GILBERTUS*, the beſt *Iron* is got out of the *Load-ſtone*.

II. *The Definition of the Load-ſtone and Iron.*

The *Load ſtone* therefore *is a Stone, reſembling the Matter that conſtitutes the Middle part of the Earth, which having Pores from one of its Poles to the other, fitted for the free paſſage of the ſtriate Matter, can turn it ſelf towards one of the Poles of the Earth.* It is ſaid to *reſemble the Middle part of the Earth*; becauſe the *Load-ſtone*, of all other *Stones*, ſeems to be of the ſame make and compoſition with the Middle part of the *Earth*. By the *ſtriate Matter* mention'd in the Definition, we are to underſtand the *Matter* of the *firſt Element*, twiſted in the manner of the *Tendrils* of a *Vine* or *Ivy-Buſh*. It is ſaid, that it *can turn it ſelf to one of the Poles of the Earth*; becauſe a *Load-ſtone* being left without impediment, always turns it ſelf to the *Poles*. *Iron is a Metal of Affinity with the Load ſtone, endued with Pores, accommodated for the free paſſage of the ſtriate Matter, by which means it is able to turn it ſelf to the Poles of the Earth.*

III. *The Virtues of the Magnet may be referr'd to three Heads.*

The *Virtues* of the *Load-ſtone* may be referr'd to three Heads; whereof the *Firſt* is, that being in a free *poſition* without any thing to hinder it, it ſpontaneouſly directs it ſelf to the *Poles* of the *World*. *Secondly*, That it draws *Iron* or another *Magnet* to it ſelf, and ſometimes alſo repels the ſame. *Thirdly*, That by a *Touch* it communicates to the *Iron*, as well the *virtue* it hath of pointing to the *Poles* of the *World*, as that whereby it draws *Iron*.

IV. *The Celeſtial matter is the Cauſe of all the Motion in the World.*

For the better underſtanding of theſe *Virtues* of the *Load-ſtone*, we are to ſuppoſe in the *Firſt* place, that the *Heavenly matter* is the *Principle* of all the *motions* of the *World*; which, as it conſiſts of moſt ſubtil and thin *parts*; ſo it eaſily penetrates the *Pores* of all *Bodies*, and according to the different degree of its agitation, doth put them into *motion*, and puſh them forward; and being *fluid*, doth accommodate it ſelf to the narrow Spaces through which it paſſeth, and puts on various *Figures*, according to the diverſity of their ſituation; ſo that its *particles* which paſs through the *Triangular Spaces*, which are left in the midſt of three *Globuli* of the *ſecond Element* touching one another, muſt take upon them a Three-corner'd *figure*, which we may conceive as ſo many little *Pillars*, with three hollow'd *Channels*, winding like a *Screw*. And this more or leſs, as they paſs nearer to, or further from the *Axis* of the *Vortex*, becauſe the *Globuli* of the *ſecond Element* move more ſlowly in the former part of the *Vortex*, than in the latter; as it hath been declared more at large in the *Fifth Part* of this *Inſtitution*.

V. *The Striate Particles are variouſly crook'd and turn'd.*

We are likewiſe to Note; that becauſe the *Striate particles* come towards the Middle of *Heaven* from contrary *Quarters*; that is, ſome of them from the *South*, and others from the *North Pole*, whilſt in the mean time the whole *Vortex* is moved one and the ſame way; therefore thoſe *Particles* which come from the *Southern Pole*, cannot have their Screw turn'd the ſame way, as thoſe which come from the *Northern Pole*, but the quite contrary.

VI. *How the Striate Particles, that proceed from the Earth, do affect the Load-ſtones that come in their way.*

Again, we are to ſuppoſe that in the Region of the *Earth* C A D B, there are many *Pores* parallel to its *Axis*, through which the *Striate*, or *Screw-like Particles*, coming from the *parts* about one *Pole*, may paſs freely to the other oppoſite to it; but foraſmuch as they are *writh'd* a contrary way, and that the one go one way, and the other quite oppoſite, the *Pores* which admit the *Striate particles* that come from the *South Pole* A, will never be able to receive thoſe that proceed from the *North Pole* B. Whence it comes to paſs, that thoſe *Particles* that proceeded from one *Quarter*, can never return by the *oppoſite* part, becauſe of the different writhing of the *Pores*, and becauſe of ſeveral moſt minute *fibres* ariſing in them, which obſtruct their return. So that after the *Striate Particles* have run through that Great *Load-ſtone*, the *Earth* C A D B, in *Right Lines*, or equivalent to ſuch, from one *Hemiſphere* to the othe other; or from the *North* B to the *South* A, or elſe quite contrary from A to B, they are forced to return to the ſame *Hemiſphere* through which they at firſt entred the *Earth*.

Figure 41.

VII. *About every Magnet a Vortex is formed, as about the Earth.*

So that about every *Magnet*, as well as about the *Earth*, C, A, D, B, a perpetual *Voxtex* of the *Striate Matter*, which is manifeſt from this Expe-riment, that if you caſt the *filings* of *Iron* or *Steel* round about a *Load-ſtone* laid upon *Paper*, the ſaid *filings* will diſpoſe themſelves a-round the *Load-ſtone* in manner of a *Vortex*. Wherefore if you ſhall direct the *North Pole* of a *Load-ſtone* you hold in your hand, to the *North Pole* of another *Load-ſtone* plac'd upon a piece of Cork in a *Baſon* of *Water*, the *North Pole* of the later *Magnet* will turn away from that you have in your hand. But when the *Load-ſtone* placed on the *Water*, being turned about, directs his *South Pole* to the *North Pole* of the *Magnet* in your hand, then it will approach to it, becauſe the interjacent *Air* being driven away by the *Striate Matter*, the *Loadſtone* is alſo puſht forwards by the *Air* that ſurrounds it. Whence it is that the *Poles* of a *Loadſtone* are ſaid to be of a contrary virtue.

And if by chance the *Striate Particles*, in paſſing from one *Hemiſphere* to another, do there meet with the *Load-ſtone* I, K, L, M, N, foraſmuch as they find in the ſame, *Pores* ranged in the ſame manner, as the *Pores* of the inward part of the *Earth*, they eaſily and freely paſs through them; eſpecially if the *Load-ſtone* be ſo poſited, as to have the arangement of his *Pores* turn'd towards that quarter, from whence the *Sriate Particles* proceed.

More-

VIII. *The Striate Particles do not so easily pass through the Air or Water, as through the Earth.*

Moreover we are to observe that the *Striate Particles* cannot pass so freely through the *Air* or *Water*, as through *Iron*; for they being *fluid Bodies*, their parts cannot always keep the same situation, and therefore if at any time such *pores* come to be formed in them, they are presently again spoil'd and confounded by the continual agitation of their *Parts*. Those *Bodies* only are disposed to admit the *Striate Particles*, that consist of *Thick* and *Branchy Parts*, such as rationally we may believe *Iron* and *Steel* to have. For of all *Metals*, none is either with more difficulty *melted* in the *Fire*, or extended under the *Hammer* than *Iron* is, or made *harder* without the addition of any other *Body*: which three instances abundantly shew, that the *Particles* whereof it consists must be Angular and *Branchy*, which is the reason they are so closely knit together, this being the most necessary condition in order to the free transmission of the *Striate Particles*. For we find that *Iron* temper'd and hardned, doth more freely afford them passage, than other *Iron*; and so likewise 'tis observed, that when the *Iron* is smooth and burnisht, the *Striate Particles*, that proceed from one *Pole* do more orderly return to the other.

IX. *In every Magnet are two Poles, an Axis, and Parallel Lines.*

For the better understanding of this *Magnetick virtue*, we are to take notice, that in every *Load-stone* there be 2 *Poles*, *South* and *North*. *The* South Pole *is the Point* A. *being the middle of that part wherein are the Orifices of the Pores, by which that striate matter enters, which comes from the* South *part of Heaven: and the* North *Pole is the middle of the other part, by which these Striate Particles go forth, and others coming from the* North F, *do enter.* Besides the *Poles*, considered in a *Load-stone*, there is also its *Axis*, or the *Diameter* from the *North* point F, to the *South* A, drawn through the *Center* of the *Load-stone*. And lastly, its *Parallel Lines*, which being drawn from the *North* to the *South*, are at an equal distance from the *Axis* of the *Load stone*.

Figure 42.

X. *Why the Magnet points to the Poles of the Earth.*

These things being premised, it will not be difficult to explain, why a *Load stone* turns its *Poles* to the *Poles* of the *Earth*; because the *Magnetical Particles* coming from the *North Pole* F, and *South* B of the *Earth*, rushing obliquely against the *Poles* of the *Magnet*, do push it this way and that way, till that they can freely, that is in right *lines*, pass through its *Pores*.

XI. *How one Load-stone turns to another.*

And it is for the same reason that one *Load-stone* turns to another. But it is to be observed, that the *South pole* of the *Magnet* always turns to the *North pole* of the *Earth*, or of another *Load-stone*; because the *particles* that come forth from the *South pole*, are writhed another way than those that enter. Whence it is that the *Poles* of the same *denomination* do always flee from one another. As for instance, suppose we that the *Poles* of 2 *Magnets* be turned to the *North Pole* of the *Earth*; these 2 *Poles* are of the same Denomination, because the *Particles* that flow from the *North Pole* of the *Earth*, do act upon them after the same manner; but it is apparent that these *Poles* flee one another, and therefore would flee from the *Pole* of the *Earth* also, in case they were of the same Denomination with it.

XII. *A Load-stone flees from another, if it be apply'd to the same Pole.*

For the same Reason it is that a *Load-stone* being set on one end on its *North Pole*, and swiming on a piece of *Cork* in the *Water*, if to the *South Pole* of this *Load-stone*, the same *Pole* of another *Load-stone* be applied, the *Cork* flees away from it; for seeing that the *Particles* cannot enter those *Pores*, they require some space, in the which turning themselves, as in a *Vortex*, they may return to their *North Pole*.

XIII. *Whereas it draws near to it, when apply'd to the oppesite Pole.*

When the *North Pole* of one *Load-stone* is turned to the *South Pole* of another, and that the *Spheres* of both of them become one, then they approach to each other; because in this case they act with their joynt forces upon the *Air*, and therefore make it withdraw; which, by its Circulating, pusheth on both the *Magnets* till they come to touch one another.

XIV. *Why the Poles of a Load-stone, that are of the same denomination, do not unite or come together.*

But some, it may be, will demand, Why for the same Reason the *Poles* of the same denomination do not as well come together; or, why the *Magnet* doth not approach to their *Bodies*, seeing that the *Air* in both cases is alike prest upon?

The Answer to this is obvious, for the *Magnetical particles*, because of their different way of wreathing, finding no fit passages for themselves in the *Pole* of the same denomination, do greatly hinder this Conjunction. And the same is the reason, why it doth not draw near to other *Bodies*, since the *Magnetical matter* doth not find any corresponding *Pores* in them.

XV. *How a Load-stone attracts Iron.*

From what hath been said, it will not be difficult to explain, how a *Load-stone* draws *Iron* or *Steel*; or rather how a *Load-stone*, *Iron* and *Steel* draw near to each other: by saying that the *Load-stone* B. attracts the *Iron* C. because both their *pores* are so disposed, that the *striate matter* A, which comes from about the *Poles* of the *Heaven*, and continues its course through the *pores* of the *Earth*, that are *parallel* to the *Axis* thereof, passing more easily through the *pores* of the *Load-stone* B. and of the *Iron* C. than of other *Bodies*, drives away the intermediate *Air*. Now because the *Air* finds no place (for there is no *Vacuum*) to which it might pass, but that which is left by one of these two *Bodies*; it cannot be otherwise, but that the *Load-stone* B, must be push'd towards the *Iron* C, or the *Iron* C towards the *Load-stone* B. For this is a General Rule, That the Virtue of the *Load-stone* is increased or diminished, according to the approaching or withdrawing of the *Iron*. It is *increased*, when the *Load-stone* and *Iron* are so disposed, as that the one sends its *Striate particles* into the other; but *diminished*, when the *Iron* is withdrawn from the *Magnet*, or the *Magnet* from the *Iron*. For the Communication of the *Striate matter* being by this means removed, their force must needs be weakned and lessened.

XVI. *How the Air thrusts forwards a Body.*

This will not be hard to conceive, if we take notice, that the Parts of the *Air*, as of all other *fluid Bodies*, are in continual *motion*, and that therefore of necessity they must push continually towards the *Load-stone* B, which they surround on every side: And because they equally push it forwards on all sides, they do not push it more one way than another. But when the *Air* is driven out of its place by the *Striate matter*, proceeding from the *Magnetical Body* at *A*, it so happens that the *Magnet* is less push'd forwards on that side, than on the other, and so approacheth to the *Iron* C, or on the contrary.

Where-

XVII. *The Sphere of the Magnetical Activity.*

Wherefore the *Sphere of Magnetical Actions* is conceived to be about the *Circuit* D E, within which the *Striate particles*, composing the *Vortex* from F to G, can affect *Bodies* that have their *Pores* dispos'd alike. And this *Sphere* is by so much the greater, as the *Load-stone* is bigger, or at least the longer it is; because the *Magnetick matter*, passing through the longer *Pores* of it, thereby acquires the force of passing farther in a *strait Line* in the *Air*; which makes, that the Virtue of great *Load-stones* doth reach farther than that of small ones.

XVIII. *The Magnet doth not properly draw Iron.*

Hence it appears, that the *Load-stone* B, cannot properly be said to draw the *Iron* C; because in this Action there is no *Attraction* at all, but as soon as the *Iron* C, is placed within the *Sphere* of the Activity of the *Load-stone* B, it gets strength, and is carried towards the *Magnet*; which Action doth not so much deserve the Name of *Attraction*, as that of *Circumpulsion*, or of being push'd forwards on all sides.

XIX. *Why an Armed Load-stone bears much more Iron, than a bare one.*

There still remains one Difficulty behind, which is this: If there be so great a Correspondence betwixt the *Pores* of a *Load-stone* and *Iron*, how comes it to pass, that the *Load-stone* A B, *armed* with *Iron*; that is, to which the *Iron Plates* C D, and E F, are fastned, should carry much more *Iron*, than one that is bare. To which I return this Answer, That this greater Force or Virtue, doth not proceed from the *Iron* that is fastned to it, but from the *contact* of it; because the *pores* of the *Iron Plates* C D, and E F, do exactly answer to the *Pores* of another *Iron*, and their Parts are so joyned, as to appear immediately to touch one another. Whence it is that the *Striate matter* passing through these *Pores*, from the *Iron* fastned to the *Load-stone*, to another *Iron b a*, doth with more ease drive away the intermediate *Air*, and make them more closely cleave together. Now the *Pores* of the *Magnet*, cannot so immediately agree with the *Pores* of the *Iron*, by reason of its *Impurity* and *Stony Nature*. Which makes, that there is always some Interval between the *Load-stone* and the *Iron*, by which the *Striate matter* doth remove from the *Pores* of the one, to those of the other.

Figure 43.

XX. *The Contrariety of the Poles of the Load-stone, do not hinder their concurrence to bear up the Iron.*

Neither doth the Contrariety of the *particles* of the *Striate Matter*, whereby those that enter at one *Pole*, cannot enter in by the other, hinder them from agreeing to bear up the *Iron*; because those that come from A, the *South* Pole of the *Load-stone*, being reflected by the *Steel-plate*, enter in at one part of the *Iron b*, in which they make its *North* Pole, and flowing from thence to the *South* Pole *a*, they meet with others of the *Steel-plate* F E, by which they mount up to B, the *North-pole* of the *Load-stone*; and on the contrary, those that go out from B, through the *Plates* F E, the *Iron* that hangs at it H G, and the other *Plate* D C, return to A.

XXI. *Why a Load-stone, be it never so strong, cannot draw an Iron that is not contiguous to it from another.*

Neither can any other Reason be given in my Judgment, why a *Load-stone*, tho' never so strong, cannot withdraw an *Iron* that is distant from it, from the *contact* of another, tho' much weaker *Magnet*; because tho' the *Striate particles* pass through both those *Magnets*, and the intermediate *Iron*, so that one only *Load-stone* is made of them all three; yet by reason of the *Contact*, and a greater agreement of the *parts*, the *Iron* cannot be withdrawn from a weaker *Magnet*, to which it is joyn'd, by a stronger. Forasmuch as the *Load-stone*, not only joyns the *Iron* to it self, but over and above communicates its virtue to it.

XXII. *The Load-stone communicates its Virtue to the Iron.*

It remains still to be explained, how the *Load-stone* communicates its *virtue* to the *Iron*, without any loss of its own strength and virtue. The *Iron* acquires this New virtue, when it hath *pores* fit for the receiving of the *Striate Particles*, and so situate, that they can freely pass through them, as hath already been said. For nothing is wanting to it towards the acquiring of this Virtue, save only that some small *ends* of the *Branchy particles*, which stick out here and there in those *pores*, must all of them be turned away in those *pores*, through which the *Striate Particles* that come from the *South* are to pass; whereas in the other *pores* they must be turned the quite contrary way. Now as soon as the *Load-stone* toucheth the *Iron*, the *Magnetical particles* rush with great force and in crowds into the *pores* of the *Iron*, and by this means bow these Extremities of the *Branchy particles*; and consequently contribute all that which was requir'd to the *Magnetical virtue*.

XXIII. *How Red-hot Iron comes to acquire a Magnetical Virtue.*

Hence it is, that when a *Gad* of *Steel* or *Iron* being Red-hot, is set to cool, with its Extremities turn'd directly *North* and *South*, it is, by reason of its *contexture* and *pores*, which the action of the *Fire* hath clear'd and opened, immediately penetrated by the *Magnetical Effluvia's* of the *Earth*; which continually do course it through the *Air* from one *Pole* to another, and so becomes endued with a *Magnetical property*: Which doth not so happen in an *Ingot* of *Silver* turn'd South and *North*, and that because of the difference of its Contexture, and disposition of its *Pores*.

XXIV. *How it comes to pass that an Iron, according as it is variously apply'd to a Load-stone, doth also differently receive its Virtue.*

An *Iron* differently receives the *Magnetical virtue*, according to its different way of application to the *Load-stone*. For the part *R*, of the *Iron* R S T, if it be apply'd to the *North*-Pole of the *Magnet* P, will become the *South* Pole of the *Iron*; because the *Striate particles* coming from the South, will enter in by it, and the Northern will enter in by the part T, being reflected or beat back from the *Pole* A, through the *Air*. And the same part R, if it lye upon the *Æquator* of the *Load-stone*, and look towards its *North* Pole, as in C, it will again become the *South* Pole of the *Iron*. But if it be turn'd about, and look towards the *South Pole*, as in D, then it will lose the Virtue of the *South Pole*, and become the *North Pole*. Lastly, If the Middle part of this *Iron* S, touch the *Pole* of the *Magnet* A, the Northern *Striate particles* which have entred into it by S, will go out again by R and T; and by this means the *Iron* will receive at both ends the Virtue of the *South Pole*, and in the midst that of the *North*.

Figure 44.

XXV. *Why a long piece of Iron doth not receive this Virtue, but in its length.*

It may be Queried, why those *Striate particles*, that from the *Pole* A of the *Magnet*, do enter the part of *Iron* marked S, do not directly pass on to E; but are reflected this way and that way towards R and T; so as the *Iron* receives the *Magnetick virtue*, rather according to its *Longitude*, than to its *Latitude*? The Answer to which is obvious, *viz.* because they meet much more free and open passages in the *Iron*, than in the *Air*; for which Reason they rebound from the *Air* towards the *Iron*.

XXVI. *A Plate of Iron hinders the attractive Virtue of the Load-stone.* There is also another Difficulty remains to be explained. *viz.* how the *Iron Plate* D C D, being apply'd to the *Pole* of the *Magnet* A B, which, we said before, did much help the carrying or bearing force of the *Load-stone*, should notwithstanding hinder its force of attracting and turning *Iron* to it; so as to make the Point E of the *Magnetick Needle* E F, not to be directed to the *Pole* of the *Magnet* B, but towards the end of the *Iron Plate* D. To which we Answer, That the *Striate particles*, which, if this *Plate* had been out of the way, would have past from B, toward E F, are diverted by it from C, towards the Extremities thereof D D, because they find a more ready and free passage for themselves through the whole length of the *Plate* from C to D, than through the small interval of its thickness C. To this may be added also, that the *Striate particles* do pass more freely through the *Plate*, than through the *Air*, so that scarcely any of them reach the *Needle* E F.

Figure 45.

XXVII. *Iron is more apt to receive the Magnetick Virtue according to its length, than breadth.* Wherefore, tho' *Iron* be made partaker of the *Magnetick virtue*, yet doth it more readily admit it according to its length, than according to its breadth, even then when the Middle part of it is applied to either of the *Poles*: The Reason whereof is, because the *Striate particles* proceeding from the *Load-stone*, do find fitter *Pores* for them in the *Iron*, than in the *Air*, which is the reason why they go towards it. This likewise is the Cause why *Needles* endued with the *Magnetick virtue*, have the *Poles* of their *virtue* at their Ends or Extremities.

XXVIII. *And this in a moment.* This Virtue is communicated, as it were, in a moment, the course of the *Magnetick particles* through the *Iron* being very swift; because they meet with, in the *Iron* and *Magnet*, Pores exactly fitted to their *figure*. Now this Virtue is afterwards confirmed by long stay; for the longer that the ends of the *Branchy particles* have continued turn'd one way, it is with the more difficulty that they are turn'd the contrary way. This Virtue is longer retain'd in the *Load-stone*, than in the *Iron*; because the parts of the *Magnet* are more stiff and inflexible, by reason of the *Stony matter* that is mixed with them.

XXIX. *Steel better keeps the Magnetical Virtue, than common Iron.* Hence it is that *Steel* receives a greater *Magnetick virtue* than common *Iron*, forasmuch as it hath more and more open *Pores*, and doth more surely keep, and preserve the same; because its *Branchy particles* are more stiff and rigid.

XXX. *The Reason why a Load-stone loseth nothing of its Virtue.* The Reason why the *Magnet*, tho' it communicates its *virtue* to the *Iron*, yet loseth nothing of it, is, because nothing of its Substance or Constitution is destroy'd by this *Contact*, seeing this whole operation is performed by the *Striate matter*; which tho' it be hurried forceably and abundantly through the *Pores* of the *Load stone*, yet by its passage takes nothing from the *Magnet*, nay, rather its *virtue* by this free communication thereof, is much increased.

XXXI. *By what Efficiency Glass and Amber draw to them bits of Straw and Stubble.* And here, seeing that besides the *Load-Stone* there be some other things that draw to them outward *Bodies*, such as *Glass*, *Amber*, *Jet*, *Diamonds*, which attract bits of *Straw* and *Stubble*; it will not be amiss to say something of them. And first concerning *Glass*; it seems probable that besides those Intervals, which in other *Bodies* give a free passage to the Matter of the *first Element*, there be some *Long pores* like unto *slits*, and so *narrow*, that they are only fit to admit the Matter of the *first Element*, without being capacious enough to receive the *Globuli* of the *second Element*. And forasmuch as the Matter of the *first Element*, accommodates it self, as hath been said, to the *Pores* through which it passeth, and assumes their *figures*, as it is wandring through those *little Slits* or *Chinks*, it becomes turned into certain *Wreaths* or *Twists*; which because of the various disposition of the parts of *Air*, being not able to penetrate its *Pores*, do remain in their own lodging, and there move from one *Chink* to another by a *Circular motion*. So that when a piece of *Glass* is rubb'd hard and swiftly against some other *Body* till it grow hot, the *particles* lodged in the *Glass* are by this agitation first thrust out of their places, and so being driven from the *Glass*, and flying through the *Air*, penetrate the *Pores* of other *Bodies*: But because they cannot so freely course it between their *parts*, they soon return to the *Glass* again, and carry along with them those *small Bodies*, out of whose *Cavities* they cannot extricate themselves. And the same may be said of *Diamonds*, *Amber*, *Jet*, *Rosin*, *Sealing-Wax*, and the like, since we suppose the same *Intervals* or *Pores* in them, *viz.* such as only can admit the Matter of the *first Element*, and that their *Particles* have the same *force* to enter the *Pores* of *Bodies*, and of carrying them along with them.

CHAP. XI.

Of Water.

I. *What Water is.* WATER *is a congested Mass of Particles of the Third Element, which are very thin, longish, smooth, and therefore very flexible, resembling small plying Cords, disposed to bend and yield every way.*

II. *The Particles of Water are smooth.* That the *Particles* of *Water* are smooth, may easily appear by *Bodies* that are wetted therewith; which with the least degree of *Heat*, or with the *motion* of the *Air* only are dried. For the *Particles* of *Water* are by this means separated, and by force of the Motion of *Heat*, or the Agitation of the *Air*, driven out from the *Bodies* to which they were joyned. Hence it is, that *Water* is not frozen without some difficulty; for its *Particles* being smooth, are readily separated from one another, by the Agitation of the *Æthereal matter*.

III. *That the Particles of the Water are in continual motion.* Now that these *Watry particles* are in continual *motion*, besides what we have *already cleared in our General Physiology*, may be proved by these *Instances*, *viz.* that *Liquors pour'd together* do readily mingle; that *Oil* and *Water*, by strong shaking, become incorporated together; that *Colours* and *Tastes* are, as it were, in an instant diffus'd through all the parts of them, and other such like, which occur to our daily Experience.

IV. *Whence Water hath its Liquidity.* Forasmuch as the *Subtil matter* is in perpetual *motion*, and never ceaseth to agitate the *Bodies*, through which it passeth; it needs not seem strange to us, that it should make the *Water* Liquid, seeing it moves all its *Particles* one by one, and bends them one upon another. And on the contrary, when

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S.r Richard Comptroller of Navy Royall &c.

This Plate is humbly

Dedicated by Richard Blome.

when this its Force is hindred (which chiefly happens in *Winter* time, becauſe of the *Suns* diſtance) the *parts* of the *Water* being promiſcuouſly hudled together, and without order heap'd upon one another, remain immovable, and conſtitute that which we call *Ice*. Which Conſiſtence of the Parts, is the Reaſon why *Frozen Liquors* are ſo cold, for that their Parts being deprived of the agitation of the *Subtil matter* are cloſely joyned, and therefore cannot admit any greater *particles* of the ſaid *matter* or *heat*.

V. *How Water becomes turn'd to Ice.* *Water* is never *frozen*, but when the *Heavenly matter* which runs betwixt the *Watry Particles*, becomes more *ſubtil* than is cuſtomary; by which means it comes to paſs, that the *Pores* of the *Ice* being reduced to the meaſure of theſe leſſer *particles* of that *matter*, do ſhut out thoſe that are never ſo little bigger. For which Reaſon it is that *Ice* is extream *cold*, and always keeps its Hardneſs, tho' it be kept till the midſt of *Summer*. Neither doth it grow ſoft by little and little, as *Wax* doth, foraſmuch as by reaſon of the narrowneſs of its *pores*, the *heat* cannot enter into the Inner parts of it, but as the Outward parts of it begin to melt.

VI. *Some parts of the Water are flexible, and others inflexible.* There are two ſorts of *particles* in the *Water*, *Flexible* and *Inflexible:* The *Flexible particles* are thoſe, which are agitated by the *Heavenly matter* that ſurrounds them; and of theſe, *Freſh-water* is compoſed. Theſe *Flexible particles* have no *Elaſtick force*, and apply'd to the *Nerves* that are diſperſt through the *Tongue*, they produce no *Taſte*; for wherever they meet with the leaſt reſiſtance they ſlip away. The *Inflexible parts* of the *Water* are ſtiff and ſharp, like ſo many *Swords*, and theſe conſtitute *Salt*. As appears from what hath been ſaid before.

VII. *Why Salt watr pricks the Tongue.* Hence we may ſee the Reaſon, why *Salt-water* as it were pricks the *Tongue*; for ſince the *Saline particles* cannot be made to ply or bend, by the *ſubtil Matter* which ſurrounds them, they continue *ſtiff*, and as ſo many ſharp-pointed *Needles* enter the *pores* of the *Tongue*, and entring, prick them with their Points: Whereas the *parts* of *Freſh-water* lye ſmooth upon the *Tongue*, and touch it not with their Points, but with their Sides.

VIII. *Salt-water is more heavy than Freſh-water, and lighter than Earth.* It alſo appears from what hath been ſaid, why *Salt-water* is more heavy than *Freſh*, *viz.* becauſe it abounds with thicker and more ſolid Parts, which therefore cannot be reſolved into *Vapours:* For the *Saline particles* being long and ſtrait, they cannot long continue ſuſpended in the *Air*, but that one end of them muſt hang downwards, which is an obſtacle to their mounting upwards. But *Water*, whether *Salt* or *Freſh*, is lighter than the *Earth*; becauſe quantity for quantity, it hath leſs Force to withdraw it ſelf from the *Center* of its *motion*, than the *Earth*.

IX. *Why Water is tranſparent.* *Water* is made *Tranſparent* by the *Globuli* of the *ſecond Element*, which continually paſſing through the *pores* of it, and being of ſufficient force to remove ſome of its *particles*, by this means eaſily form therein paſſages fitted for the tranſmiſſion of *Light*. And as for thoſe *Liquors* which are dark and troubled, the Reaſon thereof is, becauſe their *parts* are too thick to admit the *Globuli* of the *ſecond Element*. As is apparent in *Blood* and *Quickſilver*.

X. *Why the Surface of the Water is ſmooth and even.* The *Surface* of the *Water* is kept ſmooth and even, by the *motion* of the *Air*, which continually preſſeth down its *Outward parts*; whence it is that ſmall *Needles* being laid ſoftly upon the *Surface* of it do not ſink, but make a kind of hollow under them; but when once the *ſurface* of the *Water* is divided, they immediately ſink to the bottom.

XI. *Why the Water is not ſo fit to receive Sounds, as the Air.* Tho' the *Water* do admit the *Light*, as well as the *Air*, as being capable of the Rectilineal preſſure of the *Matter* of the *ſecond Element*, continually paſſing through its *Pores*; yet is it not ſo ſuſceptive of *Sounds* as the *Air*, becauſe its parts are thicker and more ſlowly moved. Hence it is that *Veſſels* fill'd with *Air* being ſtruck upon yield a Sound; but not thoſe that are full of any *Liquor*. And for the ſame Reaſon, *dry Wood* is more ſuſceptive of *Sound*, than *Green-wood*; becauſe the *pores* of *Dry-wood* have the ſame reſpect to thoſe of *Green-wood*, as an Empty Veſſel hath to one that is full; the *pores* of the *Dry-wood* being open and empty, whereas the other are ſtopt up.

XII. *Whence the ſaltneſs of the Sea proceeds.* It is a Queſtion much canvas'd, whence the *Saltneſs of the Sea* proceeds? Which may be thus anſwer'd, That the ſame is cauſed by the *Salt* which is mingled with its *Waters:* For *Sea-water* abounds with *Salt*, as appears by its *diſtillation*; for the *Water* diſtill'd from it is *ſweet*, and the *Salt* remains in the bottom. What ſome ſay, that the *Sea* borrows its *ſaltneſs* from ſome *Veins* of *Salt*, doth not ſeem probable; becauſe if theſe *Veins* be near the *Water*, they muſt needs have been all diſſolved long before this; for *Salt* immediately diſſolves in *moiſture*. And if the *waters* do not touch them, how ſhall they communicate their *ſaltneſs* to them? We conclude therefore, that the *Sea* is *ſalt*, and continues ſo, becauſe it abounds with many inflexible and ſtiff Parts; which tho' they may get up into the *Air* for ſome time, yet by reaſon of their Thickneſs, ſoon fall down thither again. Which is the Reaſon alſo, why they cannot, together with the flexible *particles*, paſs through the *Sand*, but are left behind.

XIII. *The Sea being ſalt, how comes it to paſs, that Freſh-water is found in it?* But tho' the *Sea* be *ſalt*, yet *Freſh-water* hath been ſometimes found in the midſt of it, and that by reaſon of the many *ſubterraneous Channels* of *Freſh-water*, which are found at the bottom of it. Thus we ſee, that the *Sea* about the *ſhoars*, which are near to the Mouths of great *Rivers*, is leſs *ſalt*; becauſe the *Freſh-water* of the *Rivers* overpowering the *Salt-water*, continue to be *freſh* for ſome diſtance in the *Sea*. As may be ſeen at the Mouth of the River *Rhôſne* in *France*, where the *Salt-water* doth not mingle with its *Freſh-water*, till at ſome diſtance.

XIV. *Water is not Naturally cold.* We are not to think with ſome *Modern Philoſophers*, that *Water* is *cold* in its own Nature: For tho' it feels *cold*, when *frozen*, this only happens to it from the *Reſt* of its *parts*, wherein the Nature of *Cold* conſiſts. But when it is in its Liquid form, it is indifferent to *Heat* or *Cold*, as being naturally ſuſceptive of a greater or leſs degree of *Agitation*, according to which it appears *hot* or *cold*. So that when *heated Water*, by degrees is reduc'd to its former *coldneſs*; this proceeds not from its Natural propenſion to *Coldneſs*, but becauſe it communicates ſome part of its Agitation (wherein its *heat* doth conſiſt) to ſome Neighbouring

bouring *Bodies*. And therefore when *Hot-water* is ſo cloſe ſhut up in any *Veſſel*, as to have no Communication with any ambient *Bodies*, it preſerves its *heat* for a long while. *Running-water* therefore ſeems to be of ſuch a Temperature, as to be a kind of Mean betwixt the Exceſs of *Heat* and *Cold*; ſeeing that by great *heat* it would all vaniſh into *Vapours*, and by exceſs of *cold* be lock'd up into *Ice*.

XV. *Hot Fountains do not receive their Heat from ſubterraneous Fires.*

Suppoſing, according to what hath been deliver'd before, that the *Earth* contains great ſtore of *Brimſtone*, *Jews-Lime*, and other inflammable *Bodies*, it will not ſeem ſtrange to us, that *Hot-waters* or *Bathes* break forth in ſeveral places of the *Earth*. Nor is it neceſſary that theſe *Bodies* ſhould be actually ſet on *fire*, in order to *heat* the *water* flowing by them: For it doth not ſeem probable, that any ſuch *matter* ſhould be able to flame in the *Earth*; becauſe the Smoak of it would ſoon choak it for want of vent, or the *ſurface* of the *Earth* muſt burſt to give it *Air*. Wherefore it ſeems more likely, that as of *Saltpeter*, *Brimſtone*, *Jews-Lime*, and *Quick-Lime* Mixtures are made, which by ſprinkling *water* upon them, do grow hot (which happens alſo to *Aqua Fortis* and *Oil of Tartar*, and to *Butter of Antimony*, and *Spirit of Nitre*, when put together;) ſo the like *Mixtures* may be under the *Earth*, and the ſame *Heat* may happen when any Moiſture comes to them.

XVI. *But from a Mixture of Heterogeneous Bodies.*

For it is not always neceſſary that *Hot Fountains* ſhould proceed from *ſubterraneous Fires*, ſeeing that a mixture of *Heterogeneous Bodies* is ſufficient for this purpoſe, as being able by Fermentation to produce the ſame effect. *Heat* therefore is communicated to *Hot Bathes*, whilſt their *water* paſſeth through Channels heated by the *fumes* from *Jews-Lime*, *Brimſtone*, or the like. For the *water*, by paſſing through theſe *Hot places*, becomes *heated* thereby, after the ſame manner as when *water* is heated in a *Stove*.

XVII. *The Qualities of Water.*

Accordingly, if the *water* of *Fountains*, before it breaks forth on the *ſurface* of the *Earth*, happen to paſs through *Juices* and *Minerals*, it acquires from them their *Taſte* and *Smell*, and ſeveral other *qualities*. For the ſtrong Scents of ſome *waters* are from *Brimſtone* and *Jews-Lime*, their Bitterneſs, from *Nitre*; their Acidity from *Copperas*; their Harſhneſs and Adſtringency, from *Alom*; their Saltneſs, from *Common Salt*; their ſharp Taſte, from *Marchaſite* or *Fire-ſtone*; their Iron taſte, from *Iron*.

XVIII. *Waters receive their Medicinal virtue from the Mineral Juices, through which they flow.*

And foraſmuch as thoſe *Juices* through which theſe *waters* flow, abound with a *Medicinal virtue*, 'tis from them that they derive it, and by means thereof are profitable for the Cure of many *Diſeaſes*. The *Purgative virtue* that ſome have being chiefly owing to *Brimſtone*, *Salt*, or *Nitre*; the *Adſtringing faculty* of others to *Alom*, which is made uſe of by *Phyſicians* againſt *Ulcers*, *Bloody-fluxes*, and *Relaxations* of the *Nerves*. Thoſe *Waters* that have a power of mollifying the *Earth*, receive it moſtly from *Brimſtone* and *Jews-Lime*. Which is the Cauſe why *Bituminous Bathes* are accounted profitable to thoſe who are troubled with the *Gout* or *Ach* in their *Hips*. In like manner *Waters* are made hurtful, by being imbued from ſome *Metallick Bodies*; ſuch are thoſe which have received a taint from *Lead*, or *Quickſilver*, or are infected with a *petrifying Juice*, or of ſome middle *Mineral*, as that of *Antimony*; and therefore cauſing *Vomitings*, and *Scourings*. And, in a word, whatſoever *Waters* exert any ſpecial Operation on the *Body* of *Man*, have it derived from *Subterraneous matters*.

CHAP. XII.

Of the Ebbing and Flowing of the Sea.

I. *The Ebbing and Flowing of the Sea is proportion'd in time, according to the Motion of the Moon.*

BY the *Sea-Tide* we underſtand the *Ebbing* and *Flowing* of the *Sea*, which twice happens in the time of 24 *hours*, and about 50 *minutes*. The *Sea-Tide* is *Regular*; tho' it do not happen at the ſame time, nor after the ſame manner in all places. For the *Sea* ſwells as oft as the *Moon* paſſeth our *Meridian*, whether above or under our *Horizon*; and it falls again, when the *Moon* is on the *Horizon*, whether it riſeth or ſets: For we find, that the *Sea* in its *motion* keeps a proportion of Time with the *Moon*; for as the *Moon* riſeth every day 3 *Quarters* of an *Hour* and 5 *Minutes* later, ſo at the ſame Interval doth the *Sea* riſe.

II. *What the Sea-Tide is.*

For *the Flowing of the Sea is nothing elſe, but the motion of the Sea-water towards the Shoars, in about Six Hours time: And the Ebbing, is the motion of the ſaid Waters from the Shoars, Seaward, in other Six Hours time.*

III. *The Tide is not the ſame in all Seas.*

The *Tide* is not the ſame in all *Seas*; but in ſome the ſame is greater, and in others leſs, yea, in ſome the *Tide* is verry inconſiderable, or none at all. In ſome places the *Flowing* of the *Sea*, is equal to its *Ebbing*, in others greater and in others leſs. The greateſt variety of *Tides* is at the *Æquinoxes* and *Solſtices*, as alſo at the different Aſpects of the *Moon*: Thus at the *Full* and *New Moon* the *Tide* runs higheſt, as it is leaſt at the *Quarters*. This is obſerv'd in almoſt all the Shoars of *Europe*, which the *Ocean* beats upon. But the *Flood* is always ſo much the greater, and comes the ſlower, by how much the Shoars againſt which they beat, lye more towards the *North*; and on the contrary is ſcarcely ſenſible between the *Tropicks*.

IV. *The Opinion of the Ancients, and ſome of the Peripatticks, concerning the Cauſe of the Sea-Tide.*

The *Ancients*, to give a Reaſon of all theſe *Appearances*, feigned the World to be a great *Animal*, which by breathing through its *Noſtrils*, placed by them at the bottom of the *Sea*, did cauſe the *Sea* to riſe and fall. But this *Monſter* is long ſince vaniſh'd into a *Chymæra*. Some of the later *Philoſophers*, *Peripateticks*, and others ſay, that this *Reciprocation* of the *Sea* proceeds from an *Occult quality*. But what is this elſe, but a Profeſſion of their Ignorance, and that in plain terms they do not know the Thing they pretend to Explicate? At this rate, it is an eaſie matter to explain all the Myſteries of *Nature*. For that which is hid is not known; and indeed we know no Effects, but ſuch as we can demonſtrate by their proper *Cauſes*.

V. *The Opinion of* Galilæus, *and of ſome others.*

Some attribute this Effect to the *Agitation* of the *Saline particles* of the *Sea-water*, by the moderate *heat* of the *Moon*. GALILÆUS, to the multifarious and unequal *motion* of the *Earth*. But theſe their *Opinions* are overthrown by this Obſervation, that neither of them gives the leaſt probable Reaſon of theſe *motions* in the upper

Hemi-

Hemisphere, when the *Moon* is in the lower; and on the contrary. The latter *Opinion* is indeed the better of the two, but somewhat obscure, and not altogether consonant to *Reason*; because it attributes less to the *Moon* than her due, who certainly hath a great stroak in this *matter*.

VI. *Some things supposed for the better understanding of the Sea-Tide.*

For the understanding of the true Cause of the *Sea-Tide*, some things are to be presupposed.

First, That the *Course* of the *Moon*, and of the rest of the *Planets* is *Elliptical*, not perfectly Round. And this is granted by all who suppose the *Heavens* to be *fluid*.

Secondly, That whilst the *Earth* is whirl'd about from *West* to *East*, in the *Center* of her *Vortex* A B C D, the *Moon* is carried in the outward Surface or Cirumference of the said *Vortex*, and in a *Months* Space absolves her Course.

Figure 46.

Thirdly, That when the *Moon* is plac'd at B, the *Heavenly matter* will be more strong between B, and 6, than between 8 and D; because it there *flows* through a narrower Space, by reason of the *Moons* presence; and therefore the place of the *Earth*, which is determin'd by the force of the *Circumfluent matter*, will also be changed, that is, the *Earth* will withdraw towards D, till the force be equal on both Sides.

VII. *The true Cause of the Sea-Tide.*

These things presuppos'd, let us consider the *Figure* where the *Elliptick* A B C D represents the *Vortex* of the *Earth*, in the midst whereof the *Earth* E F G H is placed. The *Circle* B ☾, the *Globe* of the *Moon*; 1 2 3 4, the *surface* of the *Sea*; and 5 6 7 8, the *Air*, which surrounds the *Sea*. This suppos'd, we may easily understand that the *Rising* and *Falling* of the *Sea* must proceed from the presence of the *Moon*. For seeing that all places are fill'd with *Bodies*, and that the same portion of *Matter* is preserv'd every where; it follows that *New Bodies* cannot be admitted into them, except thereby other *Bodies* be compressed, so that they that come in must thrust the others out of their places, and force them to betake themselves elsewhere. Which happens here by reason of the *Lunar Globe* B ☾; for the *Moon* being a great *Body*, and requiring a large Space to dilate it self in, she cannot ascend upon our *Horizon*, without lessening the *Interval* that is betwixt her and the *surface* of the *Earth*, and by this means forcing the *Cœlestial matter* to flow more swiftly; and consequently pressing as well the *surface* of the *Air* 5 6 7 8, as that of the *Water* 1 2 3 4 the more, which being *fluid Bodies*, do readily yield to the said pressure.

VIII. *An Objection answer'd.*

It is of no weight, to say that the *Air* and *Heavenly matter* move more slowly in the great *Diameter*, even then when the *Moon* takes up a part of it, than they move in the little *Diameter*, when the *Moon* is without the same: For it is enough, if the passage only of the *Air* and *Cœlestial matter* be more straitned in the great *Diameter*, when the *Moon* is in it, than it is when she is not, to cause the *Waters* that are in this *Diameter* to be driven towards the *Poles*, and so by this means to cause an *Ebbing* and *Flowing*.

IX. *The presence of the Moon presseth the Water and the Air in* Forasmuch therefore as it is manifest, that the *Earth* E F G H is kept in, and determin'd to the same place, by the equal *pressure* of the *subtil Matter* that surrounds it; it cannot be conceived, how that part of the *surface* of the *Earth*, which is opposite to the *Moon*, existing in the Point B, should be more pressed, without conceiving at the same time, that the *Matter* of the *Heaven* must push the *Earth* out of its place, thrusting it forwards to the opposite part D, until the *Earth*, about the Point 8, be pressed after the same manner, as about 6. Wherefore there are two *streights*, B and 6, and D and 8, made in this *Vortex* or *Heaven*, which are diametrically opposite to each other, *viz.* the one betwixt the *Moon* ☾, and the *Earth* T; and the other between the *Earth* T, and D. *two several parts.*

X. *How the Flowing of the Sea is caused.*

Whilst therefore the *Cœlestial matter*, which moves round about the *Earth*, moves more swiftly in these *Streights*, one whereof is betwixt the *Earth* T, and the *Moon* B; and the other betwixt the same *Earth* T, and the opposite part D. It presses the *Sea* 2 and 4, and drives it from thence towards those places that are free from this *Pression*, that is, towards G and E; where *swelling* by the force of its own *Heaviness*, it is driven towards the *Shoars*.

XI. *The Sea-Tide must happen twice in a day.*

And because the *Circumvolution* of the *Earth* about its own *Center*, is performed in 24 *Hours*, if we divide its *surface* into Four parts E F G H, that part of it which is at F, where the *Sea* is lowest, because of the presence of the *Moons Body*, 6 *Hours* hence will be in G, over against the Point C. where it is highest; and after 6 *Hours* more at H, and so on. Whence it follows, that the *Sea-water* must of necessity *flow* and *ebb* every 12 *Hours*, in one and the same place. And because the *Moon* every Day runs 12 *Degrees* towards the *East*, the *Tide* must be retarded, that is, come later by almost an *Hour*: For tho' the *Earth* be carried about in 4 *Hours*, and must at a certain time bring back the same part of the *Ocean*; yet because it must also run over those 12 *Degrees*, which the *Moon* hath run through before it can bring back that part of the *Ocean*, and oppose the same to the *Body* of the *Moon*, so it is that the *Tide* happens every *day* about 50 *minutes* later; and consequently between the two *Tides* that happen every *day*, there is the difference of 25 *minutes*.

XII. *Why the Waters return to the Parallel, above which the Moon moves.*

It is easie to apprehend, that if the *Earth* and *Moon* were immovable, the *Waters* that have been prest towards the *Poles*, would not return from thence; forasmuch as they would be held there by the same *Cause* that hath push'd them thither: But seeing that the *Earth* and the *Moon* are in a perpetual *motion*, it will follow of necessity, that the *Waters* which have been thrust from the *Parallel* which is under the *Moon* towards the *Poles*, must return afterwards by their own weight, from the *Poles* towards the *Parallel*, above which the *Moon* is, at that time when the *parts*, from whence they have been driven, are no longer opposite to the *Moon*.

XIII. *Why the Tide is longer in coming to the Northern parts, and therefore is greater there.*

It is apparent also, why the *Tide* must come later to the *Northern Shoars*, than to those that are further from the *North*; for seeing that the moved *Waters* are driven from the *South* part to the *North*, they must of necessity reach the nearer *Shoars* before those that are further off: And because the *Waters* that beat the *Shoars* near to the *Torrid Zone*, may pass further and flow toward the *Poles*, except they be hindred by the *Northern Coasts*, it comes to pass by this means, that the *Tide* is greater and more sensible in that part which is at a greater distance from the *Æquinoctial Line*; because the *Waters* about the *Æ-*

quator, by reaſon of the largeneſs of the *Circle*, are diffuſed towards the *Poles*, that they may be gather'd together in a narrower *Region*.

XIV. *An Objection anſwer'd.* But if any one Object here, That the *Waters*, in the ſpace of 6 *Hours*, which is the time of the Duration of the *flood*, cannot *flow* from the *Tropick* to the *Poles*; and thence conclude, that the ſwelling of the Sea towards the *Northern parts*, cannot be an effect of the preſſing of the *Moon* betwixt the *Tropicks*. I anſwer, That in order to make the Sea ſwell towards the *North*, it is not neceſſary that the *Waters*, betwixt the *Tropicks*, ſhould go to the *Poles*; but that it is ſufficient, if they only drive away thoſe that are neareſt; and that theſe again drive others before them, and ſo on to the laſt; which may be done in leſs than 6 *Hours* time, becauſe the Sea is a continuous *Body*.

XV. *Why the greateſt Tides are about the Æquinoxes.* Now the *Body* of the *Moon* continuing of the ſame *Thickneſs*, takes up more of the narrow Space, when ſhe is in the *leſs Diameter*, than ſhe does of the larger Space, when ſhe is in the *greater Diameter*; and therefore it matters not whether ſhe be in her *fartheſt* diſtance from the *Earth*, or in her *neareſt*; becauſe at either time ſhe makes the Space of the *Vortex* wherein ſhe is ſtreighter or more narrow; and it is only her preſence over againſt the *Earth* that is the Cauſe of the *Tide*, and not her nearneſs to it. And this furniſheth us with the true *Reaſon*, why the higheſt *Tides* are at the *Æquinoxes*; becauſe at the Beginnings of *Aries* and *Libra*, the *Moon* more directly acts upon the *Earth*, and preſſeth it accordingly, foraſmuch as its Plain at both thoſe times doth not decline from the Plain of the *Æquator* of the *Earth*, above 5 *Degrees*. For then the middlemoſt part of the *Earth*, or the *Æquator*, is in the *Ecliptick*, near to which the *Moon* always continues; and conſequently the Space being there narrower, the preſſure muſt be ſo much the greater. But at the time of the *Solſtices*, ſhe declines 23 *Degrees* and 30 *Minutes* from the Plain of the *Earths Æquator*. Seeing therefore that from the former direct *Oppoſition*, doth follow a great Preſſure of the *Air* and *Water*, it is no wonder if about that time the greateſt *Tides* do happen.

XVI. *Why the Tides are greater at New and Full Moon, than at the Quarters.* So likewiſe it is manifeſt, why the *Tides* at *New* and *Full Moon* are greater, than at the *Quarters*. For the *Vortex* A B C D, wherein the *Moon* is, is not exactly round, but ſomewhat *Elliptical*, and leaves a greater Space betwixt the *Earth* and its *Circumference*, about A, and C, than about B, and D. And therefore ſeeing the *Diameter*, wherein the *Moon* is when ſhe is *New* or *Full*, is narrower than that which interſects it at *right Angles*, it muſt follow, that when the *Moon* is in thoſe narrower *ſtreights* of *Heaven*, ſhe muſt with more force preſs the interfluent *Matter*, and conſequently produce greater *Tides*. But in the *Quarter* of the *Moon* about A and C, the *Tides* are leſs; becauſe the *Moon* is then in thoſe more ample Spaces, and conſequently there muſt be a leſs preſſure of the *Waters*.

XVII. *An Objection anſwer'd.* It ſignifies nothing therefore to ſay, that the *Moon* is not always nearer to the *Earth*, when ſhe is in *Conjunction* or *Oppoſition*, than when ſhe is in her *Quarters*; and that conſequently the *Tides* ought not to be greater at the *Conjunctions* or *Oppoſitions*, than at the *Quarters*: Becauſe, as I have before obſerved, the higheſt *Tides* do not preciſely depend upon the *Moons* being nearer to the *Earth*; but becauſe at the *Conjunctions* and *Oppoſitions* the *Moon* is always in the leaſt *Diameter* of the *Ellipſis*; where, whenſoever ſhe is, be ſhe nearer to, or further from the *Earth*, ſhe always more ſtreightens the paſſage of the *Air* and *Heavenly matter*, than ſhe doth when ſhe is in the greateſt *Diameter* of the *Ellipſis*.

XVIII. *Why the greateſt Tides are three days after the New and Full Moon.* The greateſt *Floods* commonly happen 3 *days* after the *New* and *Full Moons*, becauſe of the Diſpoſition the *Sea-water* is in at that time, to be moved more than ordinary: For having been ſtrongly moved the two foregoing *days*, it is no wonder to find the *Tides* ſtill to increaſe for 2 *days* after that the *Sea* hath received its greateſt Impulſion from the *Moon*.

XIX. *The Cauſe of the various Tides in the Sea, proceeds from the different ſituation of the ſeveral places,* It remains ſtill to be explained, how it comes to paſs, that ſeeing the *Moon* is the common Cauſe of all *Tides*, there is a great variety of them to be obſerved in the *Ocean*. To clear this Difficulty, I ſay, that this variety of *Tides* is often to be attributed to the *Sea-ſhoars*, which according as they are nearer or more remote, ſo the *Waters* reach them ſooner or later. Wherefore, if the *Sea* about the *Aquitain ſhoar* flows 7 *Hours*, and *ebbs* but 5; and on the contrary, if near *Canada*, it flows 5 *Hours*, and ebbs 7; if on the *ſhoars* of *Guinea* in *Africa*, it flows 4 *Hours*, and ebbs 8. If at *Venice* the *Tide* riſes many Foot high, and at *Ancona* nothing at all, or very little, this depends on the diverſity of the *ſituation* of thoſe *Coaſts*. Of this we have an Inſtance in the *Banks* of *Rivers*, between which, according to the difference of their *ſituation*, the *Water* runs either headlong, or glides away ſmoothly; runs winding and turning, or takes a ſtrait courſe. The *Aquitain Sea* therefore is longer a *flowing*, than it is *ebbing*; whereas on the *Belgick ſhoar*, the *Flood* and *Ebb* is equal, becauſe of the different degrees of their Steepneſs and Declining. So likewiſe at *Venice*, and on the *Coaſt* of *Syria*, the *Tide* riſeth much higher than with us; becauſe the former places are *ſituate*, as it were, at the end of the *Channel*; whereas the latter are in the midſt of it: For it is manifeſt, that the *riſing* or *falling* of the Water ſhaken in a *Veſſel*, is only perceived at the Extream parts of the *Veſſel*; whereas in the Middle there is nothing to be perceived, but an equal and ſimple *flowing* of the *Water*.

XX. *And from the various preſſion of the the Moon.* But to determine ſomething more particularly about this *Diverſity* of *Tides*, we are to take notice, that the *motion* of the *Waters* chiefly depends on this, That in that vaſt *Tract* of the *Sea*, there be ſome peculiar places where the *Waters* are very much preſſed, becauſe of the *Moons* preſence; and others again, where no force at all ſeems to be put upon them: Which makes that the *Waters* are driven to thoſe *places* where there is no preſſure, and ſo ariſe there againſt the *Shoars*, and make a *Flood*. Wherefore, if there be any *Waters* in the *Sea*, which becauſe of the inconſiderableneſs of their *Extenſion*, are all over cover'd by the *Body* of the *Moon*, they muſt needs be ſo equally preſt in all their parts, as that no *Riſing* or *Falling* can be perceived in them. Thus thoſe *Lakes*, *Pools*, and *Rivers* that are between the *Tropicks*, have no *Tides*, ſeeing that becauſe of the ſmalneſs of their *ſurface*, compar'd with the Bulk of the *Moon*, they cannot be ſenſibly preſt one way more than another. Wherefore

G. Froman In. I. Kip Sculp.

To Captaine Thomas Newnam of Iver
in the County of Buckingham Gent.

This Plate is humbly Dedicated by Ric: Blome

XXI. *Why some Seas suffer no Tides.* Wherefore it is no wonder, if in the *Baltick Sea*, the *Dead Sea*, and the *Euxine Sea*, no *Tides* at all are perceived; becauſe thoſe *Seas* have no enter-courſe with the *Ocean*; or if any of them have any communication with it, it is by ſuch narrow paſſages, that the agitation of the *Sea* can have no great *force* upon them.

XXII. *The meeting of Waters, a Cauſe of the diff'erence of of Tides.* To this Diverſity of *Tides*, the various Meetings of *Waters*, and difference of *Winds*, which differently agitate them, and drive them one againſt another, do much contribute. For the *Sea* flows continually from *Eaſt* to *Weſt*, which thoſe who ſail from *Spain* to the *Weſt Indies* have Experience of; for they frequently perform this *Voyage* in 30 *Day*,; whereas in their Return, they ſpend no leſs than 3 *Months*, becauſe the *Courſe* of the *Sea* is againſt them, and runs *Weſtward*. And the ſame is obſerv'd by thoſe who *ſail* from *Lisbon* to *Brazile*.

XXIII. *Why the Gulf of Venice flows towards the Weſt.* If you Object, That the quite contrary to this is found in the *Gulf* of *Venice*; for the *Sailers* tell us, that when they are over againſt *Epirus* and *Dalmatia*, they perceive that the *Waters* are carried with a ſtrong Stream *Weſtward*, towards *Venice*; and that when they are near the Coaſt of *Italy*, they are carried *Eaſtward*, towards the *Morea*. I Anſwer, That theſe *motions* of the *Waters* are cauſed by *Rivers*, which from *ſubterraneous Cavities* flow into the *Sea*; which in their coming forth, do with great Violence puſh forwards the *water* of the *Sea* that meets them, and divert it from its Courſe. Or elſe thoſe *Rivers*, being beaten back by the *Water* of the *Sea*, are forc'd to turn their *motion*, and to run another way.

XXIV. *An Objection againſt the foreſaid Explication, of the Ebbing and Flowing of the Sea.* But againſt this Explication of the *Ebbing* and *Flowing* of the *Sea*, it is Objected, *Firſt*, That if the *Moon* did drive the *Waters* from between the *Tropicks* towards the *Poles*, it would follow, that when the *Moon* is in the *Meridian*, it would be *Low-water* in that part which was oppoſite to it, and *High-water* towards the *Poles*; whereas Experience ſhews the contrary, *viz.* that the *Tide* comes in when the *Moon* approacheth to the *Meridian*, and that the *water* falls, as ſhe withdraws from it.

XXV. *Anſwer'd.* I Anſwer, That when the *Moon* is in the *Meridian*, the *Sea* muſt be low preciſely in that place which is over againſt it; but it doth not follow therefore, that it muſt be *High-water* under the *Poles*, but only that it muſt be *High-water* between the *Tropicks* and the *Poles*, and ſo it is. For we find by Experience, that the *Sea* increaſeth from about the *Tropicks*, to the moſt Northern part of *England*; and that from thence, towards the *Poles*, it increaſeth no more. Whence it is, that in the *Northern Ocean*, from about the *Latitude* of about 65 *Degrees*, to the *Poles*, there is no *Flood* nor *Ebb* at all.

XXVI. *A ſecond Objection againſt this Explication of the Tide.* In the Second place it is Objected, That the *Cœleſtial matter* which follows the *Moon*, and which moves ſomewhat ſwifter than ſhe doth, from *Weſt* to *Eaſt*, doth not only run under the *Moon*, but alſo above it, and on the ſides of it; ſo that that part of the *Sea*, over againſt which the *Moon* is, will be no more preſſed than the reſt.

XXVII. *Anſwer'd.* For Anſwer: It is certain that the *Heavealy matter* which follows the *Moon*, and is in a tendency to go ſomewhat ſwifter than ſhe doth, from *Weſt* to *Eaſt*, doth not all of it flow under the *Moon*, but that a part of it paſſeth above it, and on the ſides of it; yet doth not this hinder, but that the Way of the ſaid *matter* under the *Moon* is more *ſtreightned*, which is ſufficient to make the *Sea* to be more preſſed in that part, than in all the reſt.

XXVIII. *There is a threefold Tide.* From what hath been ſaid, we may gather, that there is a Threefold *Tide*, according to the difference of Times, *viz.* a *Daily*, *Monthly*, and *Yearly Tide*.

The *Daily Tide* is that, whereby the *Sea* in 24 *Hours* time doth twice approach to the ſame *Shoar*, and as many times retires again in this order, That the *Tide* of the *Day* following falls about 50 *minutes* later, than that of the *Day* foregoing.

The *Monthly Tide* conſiſts in this, that the *Daily Tide* increaſeth twice in a *Month*, *viz.* about the *New* and *Full Moon*, and twice decreaſeth, *viz.* in the *Quadrate Aſpects* of the *Moon*.

The *Yearly Tide* conſiſts in this, that the *Monthly Tide* twice in a *Year* riſeth higher than ordinary, *viz.* at both the *Æquinoxes*, and as often decreaſeth, *viz.* at the *Solſtices*. Wherefore if theſe 3 *Periods* be compared with the *Daily* and *Yearly motion* of the *Earth*, it will ſeem impoſſible, they are the words of GALILÆUS, in the *4th Dialog. Syſtem. Mundani*, *That Naturally there ſhould be any Tide, ſuppoſing the Earth to ſtand immovable, without betaking ones ſelf to the abſolute Power of* GOD, *and conclude, that the Sea-Tide is a ſupernatural Effect.*

CHAP. XIII.

Of the Air.

I. *Of the Atmoſphere.* THE AIR, according to the Order of *Nature*, follows the *Earth* and *Water*, to the *Surfaces* whereof it adheres and is joyned. The *Aſtronomers* call that part of *Heaven*, *Air*, into which the *Vapours* and *Exhalations* aſcend. And becauſe all thoſe *Exhalations*, which are continually breath'd forth from the *Earth* and *Sea*, are by the preſſing of the *Subtil matter*, diſpos'd into a Round *ſurface* (at leaſt as far as the agitation of thoſe *Bodies* will permit) they gave the Name of *Atmoſphere* to thoſe *Vapours*. It is various, according to the diverſity of *Heat* and *Cold*, and of the *Vapours* themſelves; and from thence proceeds a *various Refraction* and *Reflexion* of the *Rays* of the *Sun* and *Moon*, and the other *Stars* in the *Air*.

II. *There is a twofold Subſtance in the Air.* Accordingly we are to diſtinguiſh a twofold *Subſtance* in the *Air*, *viz.* one *Native* and *Primitive*, which hath been from the Beginning of the *World*, and which is the moſt pure and thin part of it: And the other *Adventitious* or *Foreign*, which conſiſts of the *Effluvia's* or *Steams* of other *Bodies*, according to the difference of *Place* and *Time*. Hence the *Air* is accounted, *Firſt*, abſolutely Pure, when theſe Steams are not ſo thick, that they can eaſily cling together, and thereby loſe the form of *Air*. *Secondly*, With reſpect to us, whilſt thoſe *ſteams* are not ſo hurtful to our Bodies; ſuch as they are at the time of *Epidemical* and *Contagious Diſeaſes*.

The

III. *What the Air is.* *The Air is a loose Body; fluid and transparent, whose Particles are so small, and so little clinging together, that they may with the least force be separated from the Globuli of the second Element and by a peculiar motion be carried independently about their own Center.* The *Fluidity* of the *Air* proceeds, from its being compos'd of very *subtil* and *thin Particles*; for tho' their irregular *Figures* seem to dispose them to cling together, yet are they forced to continue separate, because the minuteness of their Branches makes them yield to the *motion* of the *Subtil matter*, which by its great Mobility keeps them disunited, and makes them continue in a *Liquid form.* And forasmuch as its *Particles* are thin and disjoyned, every one of them moves independently from any of its *Neighbours*, and takes up that whole little *Sphere*, which is needful to its being whirl'd about its own *Axis*, keeping all other *particles* out of it.

IV. *The Property of the Air is to Polish and Smooth.* The *Air*'s Property is to polish and smooth *moist Bodies*, and to keep them from being easily penetrated; as appears in the *Water*, which easily bears a *Steel Needle*, or a Pane of *Glass*, as long as its *surface* is not broken. Now the Cause of this is, because the Parts of the *Air* are moved otherways than the Parts of the *Water*; so that by their rubbing against one another, both their *surfaces* are hardned, and made more unfit to be divided.

V. *What Vapours and Exhalations are.* But because the more *subtil parts* of *Exhalations* do compose the *Air*, it will not a little conduce to our better understanding of the Nature of the *Air*, if we explain what *Exhalations* are, and how they are distinguish'd from *Vapours*. *Vapours* therefore *are* nothing else, but *Particles of Water, which the Heat of the Sun, and the Circular motion of the Earth, have separated from one another, and raised into the Air.* And, *Exhalations are certain Particles, which by the same Causes have been separated and raised from Earthly Bodies.*

VI. *How they are said to be raised by the Sun.* When it is said that *Vapours* and *Exhalations* are raised into the *Air* by the *Sun*, it is not so to be understood, as if the *Sun* did attract *them* by his *Beams* (for such an *Attraction* is unintelligible) but only that at the *presence* of the *Sun*, or some other *Cause*, the *Subtil matter* which pierceth the *Pores* of *Bodies*, doth separate some *Particles* from them; which finding no other place but the *Air*, wherein they can move, do tend that way, in a manner not much unlike to that, whereby the *Dust*, which in *Summer* time we tread upon with our Feet, mounts upwards, and is raised up into many *Clouds*, according to the number of those that Tread it.

VII. *Another Property of the Air, is to be Rarefied and Condensed.* The *Air*, and all *Vapours*, are easily *condensed* and *rarefied*, according as they are more or less agitated. They become *Rarefied*, when they are more swiftly than ordinary tossed by the *Heat*: For seeing their *Particles* are *flexible*, the least commotion doth dilate them, and then they require a greater Space to continue their *motion* in. Again, they become *Condensed*, when they cease to be agitated by *Heat*; for then their *Particles* cling together, and are compress by *Cold*: For nothing else can be understood by *Heat*, but the *Agitation* of the *minute Particles* of *Bodies*; as by *Cold*, the Diminution or Cessation of that *motion.*

VIII. *The Air being compress, hath the power of springing back.* The *Air* that is forceably compress in any *Vessel*, hath a power of springing back (which is called its *Elastick virtue,*) and of extending it self into a larger space. By which means *Instruments* are made, which, with the help of the *Air* only, drive the *Water* upwards, as we see in *Artificial Fountains*; and others, that shoot Darts, like *Bows*. The Cause whereof is, for that when the *Air* is thus compressed, each of its *spherical Particles* hath not sufficient place left it, wherein to perform its *Circular motion*, by reason of the crowding in of other *Bodies*: And forasmuch as at the same time, the *agitation* of these *Particles* is continued, by the *motion* of the *Heavenly matter* perpetually *flowing* about those *parts*, it can be no otherwise, but they must hit against one another, and push each other out of their places; and thus at last, all of them together, make a strong push for it, to acquire a larger space.

IX. *Air condens'd, is more heavy than that which is rarefied.* *Condensed Air* is more heavy, than that which is *Rarefied*; because it contains less *Heavenly matter.* We may Experience this, by filling a *Bladder* first with a little, and *rarefied Air*; and afterwards with much, and *condensed Air.*

X. *The Distance of the Air from the Earth, is uncertain.* From the Greater or Lesser *Agitation*, or *Rarefaction* and *Condensation* of the *Air*, we conclude, that the *Compass* of the *Air* is greater in *Summer* than in *Winter*; and therefore that what is commonly said, that the *furthest distance of the Air from the Earth is of 52 Italian miles*, is vain and uncertain. And the same is to be said concerning the *three Regions* of the *Air*, and their several *Bounds*; as when they ascribe to the *Lowest Region*, the height of half an *Italian mile*; to the *Middlemost*, of three and an half; and to the *Highest*, the heigth of 48 *miles.* For seeing there are no certain Bounds whereby these *Regions* are discriminated, it is a Fond undertaking, to go about to determine their Limits.

XI. *The Air is Heavy.* Another Property of the *Air* is *Heaviness.* For as we find that the *Water* presseth the bottom it lies upon; so likewise the *Air*, which encompasseth the *Earth*, doth press it on every side; and so much the more vehemently presseth it, by how much it is nearer to the *Earth*: As appears in a *Bag-Pipe* or *Bladder* fill'd with *Air*, which thereby becomes *heavier* than it was before. The same also may be proved, by the running of *Quicksilver* out of a *Pipe* that is stopt at the Top; for the *Quicksilver* changeth its height, according as it is carried along a low, or high place; so as to be depress'd *deeper* in a high place, and mount up *higher* in a low place.

XII. *Why the weight of the Air is not felt.* If you demand, How comes it then to pass, that we are not sensible of the *weight* of the *Air*? I answer, That the Reason is, because there is as great a Force in our *Body* to resist, as there is in the *Heavy Air* to press. For our *Body* being full of *Blood* and *Spirits*, doth with no less Force resist the *pressure* of the surrounding *Air*; which is the Reason, why the *Air* with its *weight* cannot move our *Nerves*, nor impress a sense of *Heaviness* upon us.

XIII. *Whence the Heaviness of the Air proceeds.* Now the *Heaviness* of the *Air*, is to be ascrib'd to the *watry Particles* that are mingled with it; because that part of it which is diffus'd about the *Earth*, and reacheth to some certain distance, doth approach to the Nature of a *watry Vapour*, especially when many *Steams* are mix'd with it. Yea, if we may believe some Men, *Thick Air* is not only

only fill'd with *Steams* from the *Earth* and *Water*; but receives also the *Breathings* of all other *Bodies*, and abounds with their *Spirits*.

XIV. *Why the Lower Region of the Air is hotter than the higher.* The *Region* of the *Air*, which is *neareſt* to the *Earth*, is hotter than that which is at a good diſtance from it; becauſe the *Solar Rays* being more copiouſly reflected from the compact *Body* of the *Earth*, do produce a greater agitation of its *Particles*. And therefore it is that the *higher Region* of the *Air* is cold, where *Clouds*, *Snow* and *Rain* are generated; becauſe the *Rays* that are reflected from the *Earth*, do not ſo copiouſly mount up to it.

XV. *The Air is not Moiſt, as the Peripateticks ſuppoſe.* The *Peripateticks* hold the *Air* to be *Moiſt*, but without any ſufficient ground, that ever I could underſtand; ſave only, becauſe they thought it convenient to attribute two of their invented *Qualities* to the *Air*, which they call an *Element*. For tho' the *Air* be ſometime called *Moiſt*, this doth not ſuppoſe it to have an *Eſſential Humidity*; but is ſo denominated, becauſe of thoſe *Watry particles* reſolv'd into *Vapours*, that are joyn'd with it; which, when they are removed, it is called *Dry*: In which condition it cannot be turn'd into *Water*, no not by the moſt extream *Cold*.

CHAP. XIV.

Of the Elaſtick or Spring-like Force of the Air.

I. *What a Spring is.* BY the word SPRING is commonly underſtood, *that whereby a thing that is forceably bent and reduc'd to a leſs Extenſion, doth explicate it ſelf again, and ſtrive to return to its former Expanſion.*

II. *Wherein the Elaſtick or Spring-like force of Bodies doth conſiſt.* This *Elaſtick*, or *Spring*-like *Force* in *Bodies*, proceeds from the *Subtil* or *Æthereal matter*; for when any *hard Body*, by Example, the *Blade of a Sword is bent*, its parts are by this means deflected from the Convex or Jetting-ſide of the *Blade*, and approach nearer on the Concave or Hollow-ſide of it; by which means the *Pores* on this ſide, muſt needs be made more narrow. Now becauſe the *Subtil Matter* cannot exert its Force, to return through thoſe *parts* of the *bended Body*, it paſſeth through; but ſtrives at the ſame time, to reduce the *parts* thereof to that ſtate wherein they were before, it muſt neceſſarily follow, that this *Body* muſt fly back.

III. *The Air is eaſily Condenſed and Rarefied.* This Affection is moſt peculiar to the *Air*; which being nothing elſe, but a company of thin *Particles* of the *third Element*, which comply with the *motions* of the *Heavenly matter*, becomes eaſily condens'd; not only when by the decreaſe of *Heat*, and the leſs agitation of its parts, they do not with ſo great Force puſh againſt one another, as before they did; but alſo becauſe they are ſhut up within the parts of another *Body*, which compreſs them more than ordinary. And on the contrary, the *Air* is as eaſily *Rarefied*, as ſoon as thoſe *Cauſes* are removed, which reduc'd it to a leſs Space. Whether this happens by means of *Heat* let into its *Pores*, if before it was condenſed by *Cold*; or by opening the *Priſon* wherein it was ſhut up before, if by Compreſſion only it was reduced to a leſs Bulk.

For the *Air* can be dilated three ſeveral ways, either by its *Elaſtick virtue*, whereby it reſiſts its being Compreſt; or by the *Force* wherewith the *Subtil matter* ſtrives to enter again into the *Pores*, whence it hath been driven away; or, *laſtly*, by the extream *Agitation* of the ſaid *Matter*, which moving the parts of the *Air* more ſtrongly than ordinary, cauſeth it to extend it ſelf farther. And on the contrary, the *Air* becomes condenſed, either becauſe it is preſſed; or, becauſe the *Subtil matter*, which before moved its *Particles*, is ſlipt away from them; or, becauſe the ſaid *matter* having loſt part of its *Agitation*, hath no more the Force to move them as much as it did before, which makes them to lye more cloſe together.

IV. *The Air can be Rarefied and Condenſed divers ways.*

But we are to take notice, that this *Dilatation*, whereby the *Air* removes all Obſtacles that compreſs it, is and muſt be very ſudden; becauſe its *parts*, which before could not move without clinging together, do then with joynt Forces leap back, and by the force of the *Heavenly Globuli*, continually flowing about them, make an aſſault together, in order to take up a larger Space. There are various Experiments that are founded on this *Affection* of the *Air*, which we admire in *Artificial Fountains*, and *Wind Guns*, which ſhoot *Leaden-bullets*, and other things.

V. *The Action whereby the Air flies back like a Spring, is very ſudden.*

VI. *An Example of an Artificial Fountain.* For let the *Air* be compreſt in the *Pneumatick Veſſel*, the lower part of it being fill'd with *Water*, and the *Water* will ſpout out thence with ſo great force, that it will ſurpaſs almoſt any ſuppoſed height. For Example, Let the *Pneumatick Veſſel* be A B C, the lower part whereof B C contains *Water*, and the ſuperiour B A C *Air*; which being crowded into it by the *Pipe* A D, at ſeveral times; let it be compreſt, as is wont, in the upper *Cavity* B A C; then let the *Tube* or *Pipe* A D be well ſtopt, by turning the Key of the *ſide Pipe*, appearing above B. This ſuppoſed, if the Key of the greater *Pipe* D A be open'd, the *Water* will ſpout forth through the ſaid *Pipe* with great force to E, being forc'd upwards by the compreſt and condenſed *Air*. And foraſmuch as the *Air* is ſtill capable of greater degrees of Compreſſion, it is certain that the *Air* may alſo be puſh'd upwards with ſtill greater and greater force. Figure 47.

The Reaſon of this *Experiment* is this, that the *Particles* of *Air* contained in the *Pneumatick Veſſel*, being *thin*, and ſeparate from each other, do yield to the *motions* of the *Globuli* of the *ſecond Element*: But when theſe *Globuli* are by ſome force thruſt out, the *Particles* of the *Air* are forc'd to come nearer together, and entangle one another, ſo as that they can no longer whirl round, as they were us'd to do. Now being toſs'd about by the *Subtil matter*, they with their *Corners* hit one againſt another, and thruſt each other out of their place: By which means they ſo bend their Force, to get more room for themſelves, as that by that Effort they ſpout out the *Waters* with great force towards E.

VII. *Muſical Wind-Inſtruments may be play'd upon by the Compreſſion of the Air.* And for the ſame *Reaſon* a *ſtrong Wind* can be excited, by means of the Compreſſion of the *Air*, which will be able to expreſs all Variety of *Sounds*. For ſo we Experience, that even great *Organs*, by the *Pneumatick Art*, can *play* variety of *Tunes*, without any aſſiſtance of a *Muſicians Hand*, to wit, by our blowing into ſome *Pipes*, and thereby turning a *Wheel*, whoſe

Teeth ſhall tuneably ſtrike the *Keys* of the *Organ.*

VIII. *How the Wind-Gun can diſcharge Leaden Bullets.*

As for the *Wind-Gun*, which by means of *Air* only doth diſcharge *Bullets* with an extraordinary Violence, the ſame may be made after this manner. Suppoſe C A, in the *Figure*, to be a *Braſs Pipe*, or *Bore*; and let the end thereof, marked A, be well ſtopt, and be furniſh'd with its Stock, and with two Keys I and K, ſo as that one of them may touch the other; and having open'd both the *Keys*, let a *Plug* be put in at the Mouth of the *Bore* C, by the help of a *Screw*, the Operation being ſeveral times repeated, in order to a ſtronger Compreſſion; then let the *Key* K be ſhut home, and the other *Key* I be a little open'd, that by letting in of *Air* the *Plug* may be drawn forth; then let a *Bullet* be put into the *Bore*, with a little *Tow*, to keep it in; then open firſt the *Key* I, and afterwards K, and there will follow a forceable exploſion or diſcharge of the *Bullet* at a great diſtance, by force of the Compreſt *Air.*

Figure 48.

IX. *The Compreſſion of the Air raiſeth Quickſilver two Foot high, and keeps it ſo ſuſpended.*

It is from the ſame Compreſſion of the *Air*, that *Quickſilver* contain'd in a *Glaſs-Pipe*, open at one end and ſtopt at the other, remains ſuſpended 2 Foot and a quarter high; whereas *Water* is raiſed to almoſt 32 Foot. For take a *Glaſs-Pipe* A B, 3 Foot long, being open at the one end A, and *Hermetically* ſealed at the other B; let it be fill'd with *Quickſilver*, and turn'd upſide down into the Veſſel C D, alſo full of *Quickſilver*; it will clearly appear, that the *Quickſilver* will not ſink down to the bottom of the *Glaſs*, but will continue ſuſpended in the ſame almoſt 27 Inches high, at E. And the Reaſon is, becauſe the *Quickſilver* cannot ſink lower, but by preſſing the *Ambient Air*, which being already condenſed by that which lies upon it, and endeavouring to regain its former Expanſion, ſtrives againſt it, and by reaſon of the rowling of its complicated *parts*, cannot ply or give way. For tho' the *Quickſilver* be very heavy, yet can it not force the *Air*, conſiſting of thickiſh, vehemently extended, and continually rowling Parts, to a farther Compreſſion.

Figure 49.

X. *The Air proved to be the Cauſe of this Effect.*

Now that this Effect doth wholly depend on the *Elaſtick Power* of the *Air*, may be perceiv'd chiefly by this; becauſe in the *Pneumatick Engin*, invented by Mr. *Boyle*, if the *Pipe* fill'd with *Quickſilver* be thruſt into other *Quickſilver*, as ſoon as the *Air* is exhauſted, the *Mercury* no longer continues elevated 27 Inches high, but ſinks by degrees, and falls into the *Veſſel.* But as ſoon as the *Air* is let in again into the *Engin*, the *Quickſilver* riſeth again, and takes poſſeſſion again of its former ſtation.

XI. *This Sinking of the Quickſilver doth vary, according to the difference of Places.*

Yet we find that the *Air* hath not the ſame Force in all *Countries*, nor reſiſts the weight of *Quickſilver* alike; but according as the ſame is purer or more groſs, ſo the ſinking thereof is different. For tho' the *Air* be a *Liquid Body*, and be ſo ranged about the *Center* of the *Earth*, that its *ſurface* is of a *Round Figure*; yet becauſe about the *Poles*, by reaſon of the great *Cold* it is more condenſed, than in other places, it muſt needs be found there in greater abundance; and conſequently muſt lye more heavily upon the *Earth* of thoſe *Countries*, than upon thoſe that are nearer to the *Æquinoctial.* Upon which account it is, that the *Quickſilver* ſinks leſs in the *Glaſs-Pipe*, in *Holland*, *Denmark* and *Sweden*, than in *France*, where the *Air* is more thin and rarefied; and more at *Florence* than at *Paris*: So that in the Year 1643, in which this Experiment was firſt tried, the *Quickſilver* in a *Weather-Glaſs*, at *Florence* in *Italy*, ſtopt at 2 Foot and almoſt 3 Inches: At *Paris*, at 2 Foot 3 Inches and an half; and in *Holland*, at 2 Foot, and 6 or 7 Inches.

XII. *And of the Weather.*

And not only ſo, but this Riſing and Falling differs alſo, according to the Change of the *Weather*; for we find that the *Quickſilver* in a *Weather-Glaſs*, ſinks more in *Fair* than *Rainy weather*, and on a high *Mountain*, than in a low *Valley*, or any other place, where the *Air* is more Thick and Groſs, and ſo ſtrives more againſt the weight laid upon it. For the *Air* is condenſed according to the Proportion of the *weight* of the *Air* that is above it, which is always ſo much the greater, by how much the *Air* is lower; and conſequently it is neceſſary, that this Virtue be greater in that part of the *Air*, which is nearer unto the *Earth*, than in that which is farther from it.

XIII. *All the Motions that are commonly attributed to the avoiding of a* Vacuum, *are cauſed by the Weight of the Air.*

From this *Weight*, or *Elaſtick Power* of the *Air*, proceed all thoſe *motions* which are commonly aſcribed to Natures abhorrence from a *Vacuum*, and may be readily explained by it: For no other Reaſon can be given why the *Water* riſeth in a *Pump*, but only this, becauſe it is preſſed by the *Air*, that is about it, and ſo tends thither, where there is either very little or no *preſſure* at all of the *Air*, *viz.* within the *Bore* of the *Pump*, out of which the *Plug* is pull'd; as hath been explained in our *General Phyſicks*, by many Inſtances.

CHAP. XV.

Of Meteors in General.

I. *What Meteors are.*

WE come now to treat of thoſe things that are generated in the *Air*, commonly called METEORS: Which *are* nothing elſe but *certain various impreſſions made upon the Elements, exhibiting them ſometimes in this, and ſometimes in another Form.* And becauſe for the moſt part they appear on high in the *Air*, they have got the Name of *Meteors* from their Elevation.

II. *Meteors are Threefold.*

METEORS are Threefold, *viz. Fiery*, *Airy*, and *Watry*, according to the Predominion of that *Element*, which is moſt conſpicuous in them.

III. *Fiery.*

FIERY METEORS, *are thoſe that conſiſt of a fat, ſulphureous kindled Smoak.* And theſe are various, according to the diverſity of their *Figure*, *Situation*, *Motion*, and *Magnitude.* For when a *Fat kindled Smoak* appears in the form of a *lighted Candle*, wandring up and down, it is called an *Ignis Fatuus*, or *Will with the Wiſp*: When it hath the appearance of a *Croſs Bar* or *Beam*, it is called *Trabs*; when of a *Pillar of Fire* ſtanding upright, it is called *Ignis Pyramidalis*; when its parts are of unequal thickneſs, the middle parts being thicker and broader, and the ends ſmaller, 'tis called *Draco Volans*, that is, a *Flying Dragon*; when the *Fiery Meteor* ſeems to skip like a *Goat*, appearing ſometimes kindled, and at other times extinguiſh'd, it is called *Capra Saltans*, that is, a *Skipping Goat.* But the moſt wonderful and terrible

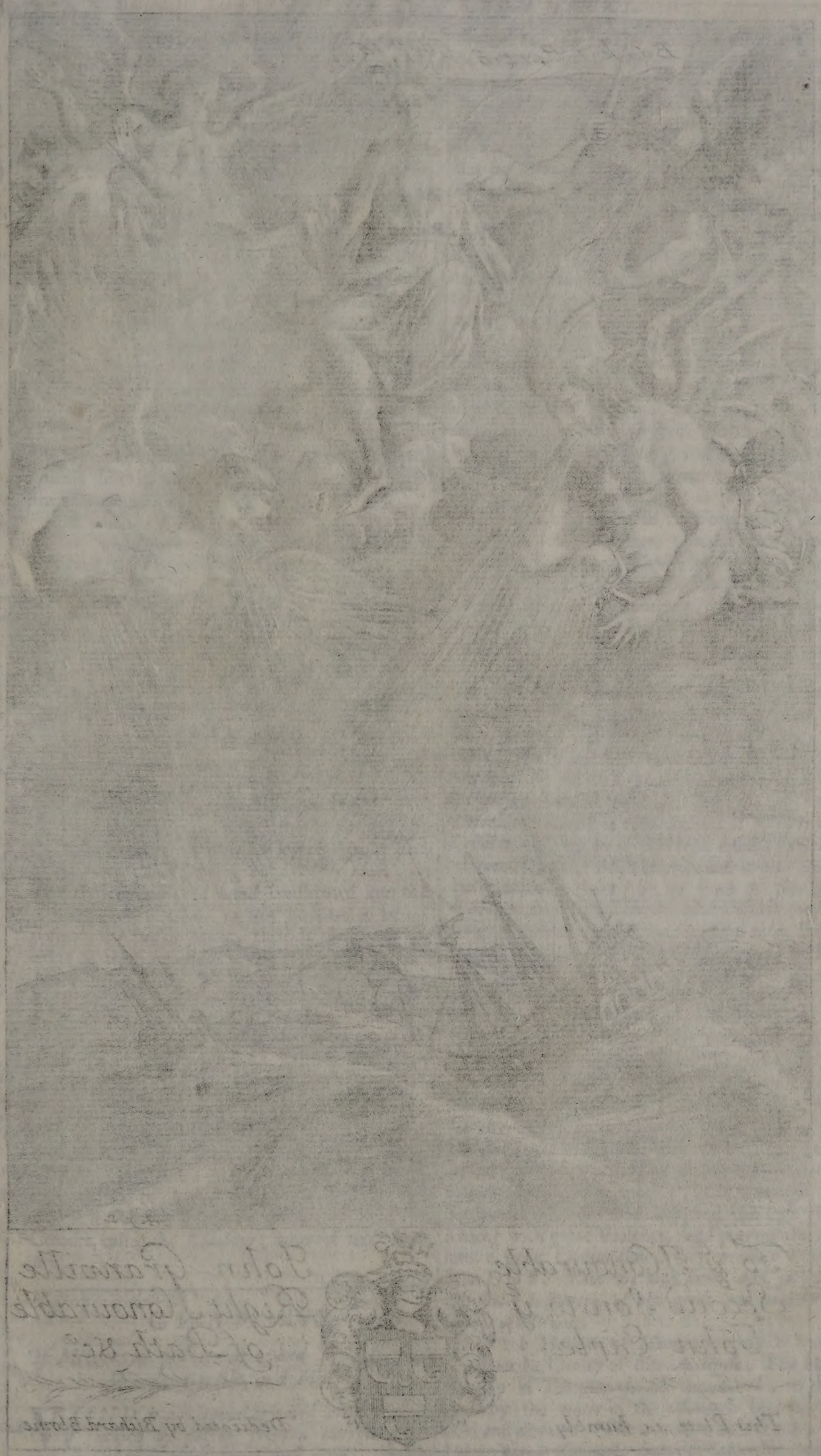
XII. And of the Weather.

XIII. All the Motions that are commonly attributed to the avoiding of a Vacuum, are caused by the Weight of the Air.

I. What Meteors are.

II. Meteors are Threefold.

III. Fiery.



To ye Honourable
Second Son to ye
John Earle

John Granville
Right Honourable
of Bath &ca

This Plate is humbly

Dedicated by Richard Blome

terrible of all the reſt are *Thunder* and *Lightning*, of which hereafter.

IV. *Airy.* AIRY METEORS, are thoſe which *conſiſt of Flatuous and Spirituous Exhalations*, ſuch as the *Winds* are.

V. *Watery.* WATERY METEORS *conſiſt of Vapours or Watry Particles, by the Action of Heat ſeparated from each other, and variouſly modified.* Theſe are manifold.

VI. *As Clouds, Snow, Rain.* For if theſe *Vapours* be elevated above the *Earth*, and hanging in the *Air*, are either by a *Weſt-wind*, oppoſing the ordinary motion of the *Vapours* Weſtward; or by *Two other Winds*, blowing from different *Quarters*; or by the alone *Coldneſs* of the *Air*, condenſed and joyned into ſome ſmall *Icy particles*, *Clouds* are generated. If theſe *Icy particles* chance to be reſolved by the *Heat of the Sun*, or of ſome *Wind* blowing from a *hot Quarter*, and the *Wind* driven together, do entangle with one another like *Carded-wool*, they make *Snow*; but if they be wholly melted into Drops, they conſtitute *Rain*.

VII. *Hail.* But when a *Cold wind* blowing congeals theſe *Drops*, when they are either altogether or almoſt diſſolved, they become turned into *Hail*.

VIII. *Miſt, Dew, and Hoar-Froſt.* If the *Vapours* hover near the *Earth*, they are called a *Miſt*, which continues either till it be drawn upwards by the *Rays* of the *Sun*; or that by its own weight, or ſome other External Cauſe, it falls down to the *Earth*; where, by a leſs degree of *Cold*, it is changed into *Dew*, and by a greater, into *Hoar-froſt*.

IX. *Appearing Meteors.* There is another ſort of *Meteors*, which are called *Appearing*; ſuch as are *Mock-Suns*, *Mock-Moons*, the *Meteor* called *Virgæ*, in the appearance of a *Fire-brand* or *Rod*, the *Rainbow*, *&c.*

X. *A Mock-Sun and Mock-Moon.* What theſe are, and how they are formed, take this ſhort account: When the Extremities or Ends of a *Snowy Cloud*, being diſſolved by *Heat*, are by a ſupervening *Cold wind* conſtipated into thin *Ice*; and ſuch a *Cloud* as this happens to be oppoſite to the *Sun* or *Moon*, then is the *Image* of either of them reflected in the ſaid *Cloud*, as in a *Looking-Glaſs*. That of the *Sun* is called *Parelius*, or a *Mock-Sun*; and the other of the *Moon*, *Paraſelene*, or a *Mock-Moon*.

XI. *Virgæ, a Meteor in the form of a Bundle of Rods.* Again, when a *watry Cloud* is compos'd of Parts, whereof ſome are more cloſe and compact, and others more looſe and lax, and the *Sun-beams* chance to pierce the more lax and open parts of it, then it exhibits a *Meteor*, repreſenting a *Bundle of Rods*, which the Latins call *Virgæ*.

XII. *The Rainbow.* Laſtly, If a *Cloud* be reſolved into ſmall *Drops*, and the ſame be illuſtrated by the *Sun* plac'd over againſt it, then is form'd a *Semi-Circle* of divers Colours, called the *Rainbow*; whereof more hereafter.

CHAP. XVI.

Of Meteors in particular; and firſt, of the Winds, Clouds, and Miſts.

I. *What Wind is.* WIND *is a Vapour agitated and rarefied, which by paſſing from a narrow place, into one that is more large and wide, ſenſibly drives the Air before it.*

II. *What is properly to be underſtood by the word, Wind.* The Name of WIND is improperly attributed to the Agitation cauſed by a *Fan* or a *Bellows*: Neither can *Air* that is moved or rarefied by *Fire*, be called a *Wind*; ſeeing that the *Air* may be variouſly moved, when yet there is no *Wind* at all; as when *Drums* are beaten, or *great Guns* diſcharged. For we ſpeak here only of a *Natural Wind*; which is nothing elſe, as hath been ſaid, but *an Agitated Vapour, which being diſtended, makes its way out of a narrower Space, wherein it was pent up, into a larger; and by this means ſenſibly driving the Air before it.* If there chance to be a meeting of many *Vapours* together, then, according to the Quantity of *Matter*, the *Wind* is ſo much the greater, and diffuſeth it ſelf far and near.

III. *Whence Vapours and Exhalations do proceed.* VAPOURS derive their Original, not only from the *ſurface* of the *Water*, but likewiſe from the *moiſt Earth*, *Clouds*, *Snow*, *&c.* for the parts of theſe *Bodies* being not ſo firmly united, are eaſily disjoyned, and ſo break forth into the *Air*; where meeting with ſeveral *Exhalations* in their way, they together with the *Air* carry them along with them; becauſe the *Air*, as well as *Exhalations*, contribute much to the Force and Violence of *Winds*. Tho' *Vapours* proceed promiſcuouſly from the *Earth* and *Water*; yet the *Sun* ſhining raiſeth more of them from the *Sea*, than from the *Earth*. And on the contrary, the *Earth* being heated with the *Sun-beams*, in the *Night* time, ſends forth more *Vapours*, than the *Sea*; becauſe the *Earth* longer preſerves the *heat* of the *Sun*, than the *Sea*. Whence it is, that in the *day time Winds* are frequently perceived to blow from the *Sea*, and in the *Night time* more from the *Land*; as at *Jamaica*, and other of the *American* Iſlands.

IV. *How Winds are raiſed, by the Example of an Æolipyle.* Foraſmuch therefore as the *Globe* of *Earth* and *Water* doth furniſh a vaſt number of *Vapours* and *Exhalations*, which for the moſt dilate themſelves between *Clouds*, *Mountains*, and other *Bodies* that are about them, by the force of this their *dilatation*, they ruſh from the places where they are ſtreightned, into thoſe where they find more Room and leſs Obſtacles, and there vehemently toſſing the *Air*, produce a *Wind*; much in the ſame manner, as we find that *VVind* is excited in *Æolipyles*. Suppoſe we therefore an *Æolipyle* A B C D E of *Braſs*, all hollow, with a very narrow *Orifice* D, by which *water* is poured into it, the part A B C, to be full of *VVater*; and other A E C, to contain nothing but *Air*. This *Æolipyle* being ſet near the *Fire*, as ſoon as it is thorough hot, many of the *watry Particles* begin to whirl round, and being elevated above the *ſurface* A C, and variouſly daſhing againſt one another, ruſh through the narrow hole D, (where they find the leaſt Reſiſtance) with great Violence, and putting the *Air* into a great Commotion, they produce a *wind* from D to F. *Thus we may know and judge by this little Inſtance, of the great and wonderful Cauſes of VVinds.* Figure 50.

V. *Mountains compared with Æolipyles.* For the Hollow of *Mountains* may be compared, to the Cavity of this *Æolipyle*: The *Heat* ſhut up in the *Bowels* of the *Earth*, to that whereby the *water* in the *Æolipyle* becomes dilated and elevated: The *water*, which the *Sea* by *Subterraneous Channels* conveys into the *Earth*, to that which is contained in the ſaid *Veſſel*: And laſtly, the *Clefts* of the *Earth*, at which the *Vapours* and *Exhalations* come forth, to the Orifice thereof.

thereof. Only with this difference, that the smallness of the Hole in the *Æolipyle* causeth the *Vapours* to rush forth with greater violence, than they do from the more open and manifold Clefts of the *Earth*. Yet doth not this hinder, but that sometimes *VVinds* may have as violent a Blast, as that which is perceived to rush through the small Hole of the *Æolipyle*; because some *Mountains* are so situated, that the *Vapours* that come from them, can but go one way, which makes them move with great *violence* and swiftness. Tho' sometimes also *VVinds* may rise in those *Countries*, where there are no *Mountains* at all, *viz.* when the *Vapours* that move from a higher to a lower Place, are by the *Clouds* or *Mists* they meet with, forced to discontinue their course, and to turn off side-way.

VI. *Which are the Cardinal Winds.*

According to the various parts of the *Horizon*, or *Quarters* whence the *VVinds blow*, they are denominated *Cardinal* or *Collateral*. The *Cardinal VVinds* are four, so called, because they blow from the four Corners of the *VVorld*. The *East wind*, from the *Sun-rising*; the *South wind* from the *South*; the *VVest wind*, from the *Setting of the Sun*; the *North wind* from the *North*.

VII. *Which the Collateral.*

The *Collateral winds* are those, which are inserted between two of the *Cardinal*; and these, according to the Account of our Modern *Seamen*, amount to 28; *viz.* 7 between the *East* and *South wind*, 7 between the *South* and *VVest wind*, 7 between the *West* and *North wind*, and as many between *North* and *East wind*. So that the *Cardinal* and *Collateral winds* put together, make up the Number of 32.

VIII. *The Names and Order of the Winds.*

To the end that the Order of the *Winds* may be the better understood, it will do well to mind the *Figure*, where they are all set down by their usual Names. The first is the *North wind*, the second is the *South-wind*, the third is the *East-wind*, and the fourth the *West-wind*; which are called *Cardinal winds*. The 4 that follow are called *Collateral*; each of which is placed in the midst of 2 *Cardinal winds*, and hath its Name composed of the 2 *Cardinal winds*, between which it is placed, *viz.* the *North-east wind*, the *North-west wind*, the *South-east wind*, and *South-west wind*. The 8 remaining *Winds*, which are placed each of them betwixt a *Cardinal* and *Collateral wind*, take their Denomination from them both: Thus that which is between the *North* and *North-east wind*, is called *North-North-east*; and so of the rest.

Figure 51.

IX. *Why the East-wind blows in the Morning, and the West-wind at Even.*

The *East-wind* is chiefly found to blow in the Morning, because the *Sun* heating the *Air*, doth dilate, rarefie, and makes it to move in one and the same *Country*; sometimes one way, sometimes another, according as he is placed with respect to that *Country*. For this diversity of Position produceth variety of *VVinds*. As for Example, When the *Sun* riseth to us, he dilates the *Air*, as hovering perpendicularly over it, and doth so whirl it round, that one part of it rusheth towards the *VVest*, where we are; whence it is that we then perceive an *East-wind*. On the contrary, when the *Sun* sets, the *Air* that is opposite to him becomes dilated, and thereupon one part of it must betake it self to the *East*, where we are then with respect to the *Sun*, and therefore must perceive a *VVest-wind*. And the same happening in all the *Countries* that are situate without the *Torrid Zone*, it follows, that in the Morning *East-winds* must blow, and at Even-tide *West-winds*: As I have expreſt it in a *Figure*, in my *History of Nature*, *Part* VI. *Chap.* II.

X. *Why the North-wind, for the most part blows in the day time.*

And with the like facility a Reason may be given, why *North-winds* most frequently blow in the *Day time*; by observing that the *Earth* E B F D, under the *Poles* E F, where it is not much heated by the *Sun*, is surrounded with *Clouds* and *Mists*; and that at B, where the *Sun* sends down his direct and perpendicular *Rays*, many *Vapours* are raised, which are carried upwards till they come thither, where, by the force of their own weight, they are more easily turned Side-ways, to continue their way towards I, and M, above the *Clouds* G, and K, than to mount higher in a *Right line*. And foraſmuch as these *Clouds* G, and K, become rarefied by the *heat* of the *Sun*, the *Vapours* proceeding from thence, do rather take their progress from G, to H, and from K, to L, than to E, or to F: For the thick and gross *Air*, which is under the *Poles*, makes a stronger resistance, than the *Vapours* that rise from the *Earth*, towards the South; for these being strongly pusht, and on all sides ready for *motion*, do easily give way to them. So that if we suppose the *Northern Pole* to be towards F, the *motion* of the *Vapours* from K, to L, will excite a *North-wind* blowing in the *Day time* through *Europe*. Figure 52.

XI. *Why the South-wind mostly blows at Night.*

Altho' the *Sun* ceaseth its Action in those *Countries*, where it is *Night*; Yet because the *heat* imparted to the *Earth* in the *Day time*, is for some time preserv'd in it, it so happens that many *Vapours* are thereby raised, which the *Air* at P, being condensed by the *Cold* of the *Night*, hinders from roaming towards Q, and R; like as those which are in the other part, wander towards I, and M; but they are there (for we suppose it to be *Night* in the part D) gather'd into *Clouds*, which hindring other *Vapours* raised out of the *Earth* from ascending to any great Height, do on every side beat them down towards N, and O, and so produce a *South-wind*, which commonly riseth at *Night*.

XII. *The East-wind is much stronger than the West-wind.*

As *Winds* proceed from different *Quarters* of the *World*, so they differ in their Properties: For those that blow from the *East*, are more violent than those that proceed from the *West*; and this partly, because these comply with the *motion* of the whole *Body* of the *Air*; and partly, because the *Air* that is dilated and blows towards the *West*, tends to a *place*, where for 18 *Hours* it hath not been *Noon*: So that by this long absence of the *Sun*, the *Air* is much more condensed, than that to which the *Western-winds* tend; because there it is not above 6 *Hours* since it was *Noon*, and the presence of the *Sun*, caused a great *heat* and rarefaction of *Vapours*.

XIII. *The North-wind is more forceable, than the South-wind.*

The *North-wind* for the most part is very *strong* and impetuous, because it is excited by the greatest *heat*, *viz.* that of *Noon-day*; and because it consists of a Matter that is most easily dissolved into *Vapours*, *viz.* *Clouds*. And for the contrary Reason, the *South-wind* must be the most gentle, as well because the *Thickness* of the *Nocturnal Air*, is a stop to its Course, as likewise because the *Matter* whereof it consist, as proceeding from the *Earth*, or from the *Water*, cannot be so readily, nor so copiously dilated, as is the *Northern matter*, which

which, as we have already said, is pour'd forth from the *Clouds*.

XIV. *The East-wind is more dry than the West.*

As to the other *Qualities* of the *Winds*, it is notorious that *East-winds* for the most part are *dryer*, and produce a more serene and clear *Air*, than those that come from the *West*; because these latter, by striving against the *Natural Course* of the *Vapours*, do stop them, and drive *Clouds* together, whereas the former do dispel and dissipate them.

XV. *Which Winds are said to be Dry, Moist, Hot and Cold.*

Hence it is evident, that the *North-wind* is of a more *drying Quality*, that is, hath a power of *driving watry Particles* out of the *pores* of *Bodies*, or from their Outsides, whilst they are expos'd to the *Air*; because, for the most part, it is composed of the grosser parts of *Fresh-water*, mix'd with the *Air*. The same *VVind* is likewise *cold*, because it carries along with it the most *subtil Northern matter*, towards the *South*, which is the *Primary Cause* of *Cold*. But the *South-wind* is *hot* and *moist*: *Moist*, because it consists of the more gross, and *subtil parts* of *Fresh-water*, elevated together from the *Earth*: And it is *Hot*, because it brings along with it the *Subtil matter*, which was in the *Southern quarter*, towards the *North*. For the *VVinds* are much alter'd, according to the place through which they pass; and therefore, according to the Nature of the *Region* through which they go, are either *Hot*, *Cold*, *Moist*, or *Dry*.

XVI. *The Regularity of the Winds is sometimes hindred by particular Causes.*

All these things we have here spoken concerning the 4 *Cardinal-winds*, would happen so continually, if the *Earth* in all its parts lay equally above the *VVater*, and there were no difference of *Soils* and *Springs*, nor any other Cause, but the *presence* of the *Sun*, to dilate the *Vapours*; but there are so many other *Causes* that conduce to the production of *VVinds*, that it is no wonder to find them so irregular, and not to rise in the same Order. Wherefore we cannot with Reason expect *Regular winds*, save only in those parts of the *Sea* which are most remote from the *Land*. Forasmuch as there is no such great inequality in the *surface* of the *Sea*, as there is in that of the *Earth*; and because the *VVinds*, which are driven that way from the *Shoars*, very rarely can reach so far, as to disturb the Course of those *VVinds* that blow there.

XVII. *What Winds are called* Perennes, *or Continual.*

Besides the foremention'd kinds of *VVinds*, some *VVinds* are called *Perennes*, that is, *Continual*; others *stati*, or such as blow at certain Times and Seasons; others, *Provincial*; and others, *Free*.

The *Continual VVinds* are 2; the one in the *Torrid Zone*, which continually blows from *East* to *VVest*: The other in the *Temperate Zones*, which, as far as about the 40*th Degree*, blows also from the *East* to *VVest*. These *VVinds* are very observable at *Sea*, but are scarce discernible at *Land*.

XVIII. *What* Venti stati *are, that is, such as blow at certain Seasons.*

VVinds, Named by the *Latins*, *stati*, are such as return at certain and set Times. The most famous of this kind are the *VVinds* called *Etesiæ*, which return every *Year*, towards the end of *July*, and continue 40 *Days* together, especially in *Italy* and *Ægypt*: They blow at *Night*, about 3 *hours* after *Sun-set*, and for the most part cease at the approach of the *Evening*. Their Course is from the *East* or the *North*, or from between them both.

XIX. *Provincial Winds.*

Provincial VVinds are such as *blow* in certain *Provinces* or *Countries*: Such is the *North-wind*, that *blows* on the *North-side* of the *Alpes*, according to the Course of a *River*, about 1 or 2 *Leagues* in length, but much less in breadth. This is a *Daily-wind*, and seems to blow continually, and with great evenness, like a *River*.

XX. *Free Winds.*

Those are called *Free-winds*, which without any order of *time* or *place*, do blow from different *Quarters*. Thus the *VVest-winds* blow most commonly about *Noon*, or after, when the *Sun* is hastning towards its *setting*. The *South-wind* frequently riseth at *Night*, and blows more vehemently than in the *Day* time; whereas the *North-wind* blows more in the *Day* time, than at *Night*.

XXI. *The Original of Clouds.*

As *Vapours* that are dilated in the *Air*, do produce *Winds*; so when they are compress and condens'd, they make *Clouds*. Which then happens, when their *motion* is diminished; for then their little *Particles* come closer together, which as soon as they are *joyned*, rise up in little heaps, and these gather'd together compose vast Bulks. For the *Clouds are* nothing else, but *Vapours and Exhalations sublim'd so high, that the Coldness of the Air makes them come together, and so to constitute a Whole, which is so loose and spungy, that it cannot by its weight overcome the Resistance of the Air, which oppeseth its descent.*

XXII. *How Clouds come to darken the Light of the Sun.*

Clouds do often interrupt the *Action* of *Light*; for tho' the *Drops* of *Water*, and the *flocks* of *Ice* whereof they consist are singly *transparent*; yet their multiplied *Surfaces* do repress the *Light* of the *Sun*. As appears in *Froth*, which because of the various *surface* of its Parts, cannot receive the *Light*. The Cause of this *Condensation* is, either the *Winds* which compress the *Vapours* together, especially if they be opposite, and blow from divers *parts*; or else the figuration of the *Particles* that compose the *Vapours*, whereby they are more fit to cling and close together.

XXIII. *How Clouds are supported in the Air.*

The Reason why *Clouds* do not fall down out of the *Air* upon the *Earth*, is, because their *Particles* are very thin, and have large *Surfaces*, their *Matter* consider'd, and therefore are easily born up by the *Air*, which is ever thicker near the *Earth*; or else are hindred by the *Winds* from coming down: Much in the same manner, as a deep loaden *Ship*, is born up by the *weight* of the *Water*. Hence it is, that according to the less, greater, or equal *weight* of a *Cloud*, it doth either ascend, descend, or hang equally pois'd in the *Air*; even as a *Ship*, proportionable to its less, greater or equal *Gravity*, doth rise, sink, or is evenly pois'd in the *Water*. But when the *particles* of the *Clouds* are so thick, that they can no longer be kept up by the resistance of the *Air*, then are they resolved into *Water*, and by their *weight* fall down to the ground.

XXIV. *The difference between a Mist and a Cloud.*

A MIST differs from a *Cloud*, only by the diversity of its place; for *Mists* are *Vapours* that reach to the very *surface* of the *Earth*; whereas those that constitute the *Clouds* are pois'd in the *Air*. For a *Mist* is nothing else, but a *Duskish Vapour*, *hovering on the Earth, which continues either till it be drawn up by the Rays of the Sun, or by its own weight, or some other outward Cause, falls down to the Earth.*

XXV. *The Original of Snow, Hail, and Rain, falling from the Clouds.*

We are to take notice that the Parts of *Ice*, whereof I have said that *Clouds* consist, are not so joyn'd together; but that there is some distance between, so as to make up several little Heaps: So that if they chance to be shaken with any strong *Wind*, they are easily separated, and fall down to the *Earth*. If these *Hillocks* or *Flocks* are not wholly dissolved, they make *Snow*. But if the *Air*, through which they are carried, be so *hot* as to make them to melt, they come down in *Rain*. It happens also sometimes, that after they are turn'd into *Drops* of *Water*, a *Cold wind* meeting with them, congeals them into *Hail*; for *Hail* is nothing else but frozen or congealed *Rain*.

CHAP. XVII.

Of Rain, Dew, Hoar-Frost, and the Cool Evening Air.

I. *What Rain is.*

RAIN is nothing else, but *those Drops into which a Vapour elevated above the Earth, is resolved.* We have a resemblance hereof in *distill'd Liquors*; for the *rising Vapour*, being condensed by the Coolness of the *Air*, returns to its former state, and runs together into *Drops*, which at first are insensible, but in their falling down are commonly increased, by others joyning with them; and those commonly are the largest, that fall down from the highest place.

II. *Whence the difference of Rain doth proceed.*

We must not therefore suppose, as some do, that *Rain* is produc'd in the *Air*, as *Water*, that by being poured from on *high*, becomes dispersed into many *Drops*; or that it is generated in manner of a *Pool*, the *Water* whereof falling from the *Clouds* is dissolv'd first into greater, and then into less *Drops*; but only by degrees and by parts: For the *Drops of Rain*, are formed of the *particles* of *Vapours* joyning together, and being joyned fall down to the *Earth*. Hence *Rain* hath got several Names, according to the different bigness of the *Drops*, whereof it consists: For the *Rain* that falls down in small or midling *Drops*, is called by the common Name, *Rain*; if it drops very small, 'tis called a *Drizling Rain*; if it falls down in great *Drops*, and those close and thick, 'tis called a *Shower*; if it comes down in great *Drops*, and fiercely, 'tis called a *Storm*.

III. *Whence the Greatness of the Drops of Rain proceed.*

The *Drops* of *Rain* are *great*, when the *Heat* acts upon the upper part of the *Cloud*; because then the *Drops* that descend do increase in their passage, by the addition of other *Drops* they meet with from the top of the *Cloud* to the bottom: Whereas on the contrary, when the action of *Heat* is only exerted on the lower part of the *Cloud*, as it commonly happens in the *Winter*, the Drops are so *small*, that they are not called *Rain*, but only a *Mizling Dew*.

IV. *How the Rain falls down from the Clouds.*

Tho' it be evident enough how *Clouds*, that consist only of *Watry Drops*, come down in *Rain*, *viz.* either by their own *weight*, when the *Drops* by the coalition of many *particles*, have attained to a sufficient thickness; or, when that the *Air* that is under them, by its withdrawing, or that which is above, by pressing upon them, inclines them to a descent; or, when many of these Causes chance to concur: But yet it is not so evident to all, how *Rain* is generated at first out of a *condensed Cloud*.

V. *Rain is sometimes caused by Wind.*

Now this will be easily made out, if we consider how 2 contrary *Winds* do gather great abundance of *Vapours* into the middle Space between them, and thereby cause the production of a *Mist* or *Cloud* there. For let us suppose, for Example, a *Wind* to blow upon the *Earth* A B, from the *West* D, and another to blow the contrary way, from the *East* C, so as that both these *Winds* come to stop one another about the Space F G P; it must necessarily follow, that the *Vapours* intercepted between the *wind* D, and the *wind* C, being driven together, must be there condensed, and make a kind of confus'd Mass. In like manner the *Wind* that drives against this *Cloud*, yet not with that Violence as to carry it along with it, must drive the parts of it closer together; by which means many of the *watry Particles*, which before were insensible, and separate from each other, are by the force of the *wind* driven together, and so become *great Drops*, which by their own weight fall down. For as in your common *Stills*, *Drops* are not formed as soon as the *Vapour* is got to the Head of them, for that other *Vapours* ascending to the top of the *Still*, must increase their bulk. So neither can *Rain* be generated, as soon as the *Vapours* are got up to the *Region* of the *Clouds*; but it is necessary, that those *Particles* of which the *Vapours* do consist, be by the *Wind* driven together, and more closely joyned; and that being thus become more heavy, so as to be able to vanquish the resistance of the *Air*, they fall down to the *Earth*.

Figure 53.

VI. *The more common Cause of Rain is Heat.*

Notwithstanding that by this way *Clouds* are often turned to *Rain*, yet is the *Heat* of the *Air* a more frequent and efficacious Cause of it. For this *heated Air* clinging to the *Clouds*, makes the *subtil Snow*, whereof they consist, to dissolve, and separates it into many little *Flocks*, which have then force enough to drive away the *Air* that opposeth their descent; and so by the action of the *Heat* they meet with in their passage, they are quite melted, and turn'd into *Drops*: Which sometimes are *large*, when the *Cloud* is thick and close, and comes down by the pressure only of the *Air* that is above it; because the *upper Drops* meet with others in their way downward, that increase them and make them larger, as before hath been mentiond.

VII. *Why the Drops of Rain are Round.*

The *Drops* of *Rain*, as they fall down, are made *round*: For a *Liquid Body* then becomes Round, when all its Parts are by an equal force driven towards some Common *Center*; for all the Parts of that *Circumference* being moved by a like force, are at an equal distance from the *Center*. Now *Rain* is a *Liquid Body*, all whose Parts, when the *Air* is calm and free from *Winds*, are compress by an equal Virtue to some Common *Center*. For the *Calm Air* doth on all sides equally compress these *Drops*, there being no Reason to be given why it should press them one way, more than another.

VIII. *How the Dew is formed.*

Having premised thus much concerning *Rain*, it will not be difficult to conceive how the DEW is formed, if we observe that when the *Air* is clear and not ruffled with *Winds*; many loose and thin *little Bodies* are dispersed abroad, especially in the *Summer time*, when *Vapours* and *Exhalations* are copiously elevated from the *Earth*:

Which

Which small *Bodies* flying in the *Air*, in the form of *Vapours*, when the *cold* of the *Night* comes on, do lose their *agitation*, and many of them clinging together, produce insensible *Drops*, which falling down upon the *Dry ground* are suck'd up; but falling upon the *Leaves* of *Trees*, or the *Spires* of *Grass*, are there gather'd into greater *Drops*. This chiefly happens in the *Night*, or before *Day-break*; because then the *Earth* is most *cold*, as being turned from the *Sun*. Whence it follows, that the *Dew* is nothing else, but *certain Vapours, that have by Heat been elevated in the Day time; and which being condensed by the Coldness of the Night, fall down in small insensible Drops upon the Leaves of Plants; where many of them joyning together, they become sensible.*

IX. *What Hoar-Frost is, and how it is distinguish from Dew.* HOAR-FROST is generated, when the *Vapours*, that are near the *Earth*, are congealed by the *coldness* of the *Night*: Which only happens in the *Winter*, when *Cold* predominates. For tho' when the *Coldness* of the *Night* is yet temperate, it be sufficient to compress the *watry Particles* up and down dispersed through the *Air*, into sensible *Drops*, yet not to congeal them: But the *Cold* of *Winter-Nights* being more intense, congeals the said *Drops* in the form of *Snow* or *Hail*. So that it appears, that the difference between *Dew* and *Hoar-Frost* is this, That *Mists* do turn to *Dew*, if they consist of *Drops* of *water*; but into *Hoar-Frost*, when they consist of *Vapours* that are *frozen* before, or are congealed in their passage down to the *Earth*.

X. *Why Hoar-Frost makes Coleworts tender.* It is observed, that the *Hoar-Frost* makes some *Herbs*, and particularly *Coleworts*, tender; the Reason whereof is, because the *Cold* acting upon them, doth very much condense them, and causeth many *humid Particles* to congeal together; which afterwards are easily resolved again by any supervening *Heat*, and by this means their *fibres* become in a manner clean dissolved, which is the cause of the Tenderness of those *Plants*. The like also happens in *Flesh*, which having been *frozen*, doth thereby grow very Tender.

XI. *What the Cool Evening Breez is, which is consequent upon clear Summer days.* As to that COOL EVENING-AIR, or *Breez*, which is consequent to fair *Summer-days*, we find that it commonly happens when the *Heat* of the *Sun* hath been very intense all the *Day* long, and thereby greatly agitated the *Air*; by which means the *surface* of the *Earth* also is moved to send forth abundance of *subtil Exhalations* upwards, to the *Region* of *Vapours*; and because these *Exhalations* do more easily lose their agitation, than the *Vapours* do, as soon as they are deprived of the *Sun*'s *Heat*, the former of these fall down. And herein doth chiefly consist the Nature of this *Cool Air*, or *Breez*; which according to the difference of *places*, is endued with different *Qualities*: For it is probable, that those *Particles* which exhale from places *Infected*, or *poisonous Plants*, are far more hurtful, than simple *Vapours* that arise out of the *Earth*.

XII. *When the Cool of the Evening is hurtful.* The *Cool Air*, or *Breez* of the *Evening*, is never more hurtful, than when the *Day* fore-going hath been very clear, and the *Heat* of the *Sun* moderate: For the immoderate *Heat* of the *Day* doth much extenuate these *Vapours*, and elevates them on high, so that they cannot so readily be condensed by the *Cold* of the *Evening*. It is also very hurtful after that the *Sun* is set, because the more heavy *Exhalations*, which have less of *Vapour* mix'd with them, as soon as they are left destitute of the *Sun-beams*, do immediately come downwards.

XIII. *If when the Air is duskish, the Sun shines in the East, it is a sign of Rain.* The *Air* cover'd with *Clouds*, is a sign of *Rain*, if the *Sun* shine in the *Morning*; for this is an evident Token, that there are no other *Clouds* in the Neighbourhood of our *Air*, towards the *East*, which can hinder the *heat* of the *Sun* from condensing those that hang over our Heads, or from raising new *Vapours*, whence they might be increased, out of the *Earth*. But this *Cause* only takes place in the *Morning*; for if it do not *Rain* before *Noon*, it cannot afford any signification of what is to happen in the *Evening*. Neither are those *signs*, which are taken from the *Croaking* of *Frogs*, or *Crows*, the *Præsentions* of *Beasts*, the *Redness* of the *Sun*, the *Paleness* of the *Moon*, and other such like, any whit more certain, but generally very fallacious: And he that would take the pains to observe them diligently, will frequently find the contrary, to what is commonly expected from such like *Presages*.

XIV. *When no Dew falls in the Morning, it is a sign of Rain.* Yet we find, that when no *Dew* falls in the *Night*, or the *Mist* is carried upwards, leaving the *Earth* destitute of all *Moisture*, this is a sign of *Rain*; because this seldom happens, but when the *Earth*, having not been sufficiently cooled in the *Night-season*; or been agitated by too much *heat* in the *Day time*, doth send forth abundance of *Vapours*, which driving the *Mist* upwards, make its Parts to run together; by which means they become so great and weighty, as that they are forced to come down in *Rain*.

CHAP. XVIII.

Of Snow and Hail.

I. *What Snow is.* SNOW may be said to be *a dissolved Cloud, which being driven downwards by its own weight, falls down to the ground in Flocks*. It is said to be a *Dissolved Cloud*; because a *Cloud* is nothing else, but a great heap of *Snow* close clinging together. And it is said to be *Dissolv'd*, because when the union of the *parts* of a *Cloud* are broken by force, one *part* of it becomes sever'd from its next *part*, and being more weighty than the *Air*, comes down in the form of *Snow* or *Rain*. It is said in the next place, that it is *driven downwards by its own weight*. For a *Dissolved Cloud*, by its own weight, either turns to *Snow*, *Rain*, or *Hail*. And lastly, it is said, that it comes down in sever'd or *distinct Flocks*. For as a *Flock* of *Wool*, consists of many *particles* of *Wool*, entangled together; so the *Flocks* of *Snow* are compos'd of may *Shaggy particles* clinging together.

II. *How Snow and Hail are formed, and why they are white.* It is not always necessary, that the *parts* of *Clouds* should be wholly melted before they come down, since it is common for them not to be *dissolved*, or to turn to *Drops*, before that they come near the *Earth*, where the *Heat* is strongest, as exceeding that which is on high. Wherefore, when the *parts* of a *Cloud* that are only condensed, without being *melted*, do meet with the *cold Air*, which is no longer able to bear them, they fall down with their own *weight*, and that in *Flocks* of *Snow*, and not in *Drops*.

To

III. *How the Snow, whereof Clouds conſiſt, is condenſed.* To underſtand the way how the *Clouds* come to be condenſed, we are to ſuppoſe that the *Heat* which commonly rarefies moſt *Bodies*, doth notwithſtanding *condenſe* that of *Snow*; whoſe Parts are ſo ſeparate from each other, that the leaſt agitation is ſufficient to bring them together. Whence it comes to paſs, that when the *Air*, which is near the *Earth*, and is always more *hot*, than that which is at a greater diſtance from it, comes to elevate it ſelf to the *Clouds*, either by the Force of ſome *VVind* that carries it along, or by the Action of ſome new *Fermentation*, which cauſeth it to ſwell, it is neceſſary that it condenſe the *Snow*, whence the *Clouds* are compoſed.

IV. *How Hail is produc'd, and what is the figure of it.* The *Flocks* of *Snow* are of a *white Colour*, becauſe the *watry Matter*, whereof they are compoſed, contain a great deal of *Air*; and its *pores* are ſo diſpoſed as to reflect the *Light*, rather than to afford it a free paſſage, as *Ice* doth. But if theſe ſmall *Flocks*, after that they are *melted* by warm *Air*, do afterwards meet with other *Air* that is *cold*, and by it are congealed; then they turn to *Hail*, whoſe *Stones* are of a different *Figure*, according to the various Solution of the *Flocks*. For if the *Cold wind*, that congeals the *Hail*, doth meet with the *Flocks* of *Snow*, when they are almoſt diſſolved, but not yet rounded into *Drops*, then they obtain an *Horned figure*; and when the *wind* meets with the *Drops* of *water* already formed, it produceth little tranſparent round *Pellets*, ſave only that commonly they are ſomewhat flattiſh on that ſide where the *wind* beats upon them.

V. *Why the Hail is ſometimes of a Conical figure.* So that from the divers degrees of *Heat* wherewith the *Air* is agitated, and whereby the *Cloud* muſt be diſſolved, there ariſeth a great variety of *Effects*. For if the *Heat*, which by the *Cold wind* is driven into the *pores* of the *Flocks*, and penetrates their inmoſt Parts, chance to drive them towards the *Center* and condenſe them, whilſt the *External parts* being become ſtiff and bound by the *Cold*, cannot follow, they muſt of neceſſity be ſlit, according to *Right lines* tending to the *Center*; and as the number of theſe Slits do increaſe, as the *Cold* penetrates deeper, they muſt at laſt fly in pieces, into many longiſh and *Pyramidal particles*, which are ſo many *Hail-ſtones*, which at the firſt approaching of *VVinter*, fall down to the ground, eſpecially if a *Spring*-like conſtitution of the *weather* have gone before.

VI. *Why it ſeldom Hails in Winter.* For it is apparent, that it cannot *Hail* much in the *Winter*; or if it doth, the *Stones* cannot be great. The Reaſon is, becauſe during that *Seaſon* there is ſeldom *heat* enough ſo high as the *Clouds* to melt them; but only when they are ſo low, as that being *melted*, or near melted, they have no time to be congeal'd again before they reach the *Earth*. Whence *Hail* may be deſcribed to be *a Cloud that is melted, either whole or in part, and being driven downwards by its own weight, becomes ſo congealed by a Colder wind, that it falls down commonly in round and tranſparent Pellets.*

VII. *Whence the different Figures of Hail do proceed.* The *Hail-ſtones* are ſometimes of an *Oval figure, viz.* when a melted or diſſolved *Cloud* is ſtronger compreſt on one ſide, by the *wind*, than on the other. Sometimes they are rough, by reaſon of many *Angles*, which happens when a *Cold wind* ſeizeth the *Flocks* of *Snow* as they are *melting*, but before they are turn'd into round *Drops* of *Rain*. To which may be added, that the *Hail-ſtones* are ſometimes ſo violently daſh'd againſt the *Earth*, as thereby to be broken to pieces, and ſo loſe their Natural *figure*.

VIII. *The various Figures of Snow.* But much more wonderful is the *figure* of *Snow*, which ſometimes is *Hairy*, as in M and Z, ſometimes *Six-corner'd*, and conſiſting of 6 equal *Rays*, like *Stars*, as in O; ſometimes like a *Roſe*, as at Q; ſometimes in the *figure* of 6 *Rays*, or like 3 *Rods* laid Croſswiſe, which like greater *Branches*, ſhoot out leſſer *Branches* from them, the broadeſt whereof are neareſt to the *Center*, ſo as to reach and entangle one another; and the ſhorteſt or narroweſt towards the Top, making a Corner'd or Angulous *Ray* or *Beam*, as in R. Figure 54.

IX. *How Snow comes to be of a Hairy figure.* HAIRY-SNOW MZ, is produc'd, when the *particles* of *Ice*, which conſtitute the *Flocks* of *Snow*, being condenſed by the *heat* of the *Air*, and ſeveral times after congeal'd by the *Cold*, whirl round their own own *Centers* in the *Air*: In which *motion* they are cover'd with ſome longiſh and ſlender *particles* of *Ice*, as with *Hair*, and ſo exhibit the *figure* of *Hairy-Snow*.

X. *How Snow comes to be formed into the figure of Stars.* *Snow* of a 6 *Corner'd* or *Starry figure*, O, is formed, when the *Wind*, which hath diſpos'd the *Flocks* of *Snow* into the form of *Leaves*, by paſſing freely betwixt them, doth melt the *particles* of *Waters*, that ſtand upright like *Hairs*; ſo that afterwards inſinuating it ſelf into the 6 *Corner'd Spaces*, it melts the moſt *ſubtil* and looſe *Snow* that is about the *Circumference* of them; and the *particles* of *Water*, being agitated by the force of *heat*, joyning themſelves with others that are not *melted*, do preſently congeal them; and ſo their *Hair*-like *Extremities* being bent this way and that way, the *Flocks* grow leſs, and are changed, as it were, into a ſmall *plate* of *Ice*. And as to thoſe *Hairy prominences*, which are melted in the Circumference of theſe *Intervals*, theſe become condenſed, whilſt they withdraw themſelves towards thoſe which joyn every one of theſe *Flocks*, to 6 others that ſurround it: By which means 6 *Breaches*, or *Slits*, are made in the 6 *parts* of the *Circumference*, where the *Heat* is moſt predominant.

XI. *How the Flocks of Snow are formed into the Figure of Roſes.* *Snow* is formed into the *figure* of a *Roſe*, Q, when the *Heat* of the *Air* is ſomewhat greater, than what we juſt now ſuppoſed: For then daſhing againſt theſe 6 *prominent Points*, it makes them ſhorter; and cauſeth the *plate* of *Ice*, which before reſembled the *figure* of a *Star*, to become like a *Roſe* with 6 *Leaves*, the *points* being rounded like the Teeth of the *Wheels* we ſee in *Watches*.

XII. *How the Flocks of Snow come to reſemble Lillies.* If the *Flocks*, whereof *Snow* is compoſed, be bigger than ordinary, it may happen that by this means it may be not only divided into 6 *places*, in order to the forming of 6 *points*; but that alſo every one of thoſe 6 *points*, be divided into 6 others, by the intervening of 2 *Breaches* or *Slits*, from the *Hairy prominences* or *Capillaments*, which reach the *Capillaments* of another *Flock* of *Snow*: So that by this means 2 *points* might be formed, bending outwards; becauſe the *Heat* there acting with more vehemence, produceth a greater Condenſation: And thus inſtead of one *Starry-point*, or a *Roſe-leaf*, there muſt appear the *Leaf* of a *Lilly*, as is repreſented in R.

Some

VIII.
The various Figures of Snow.

Figure 54.

IX.
How Snow comes to be of a Hairy figure.

X.
How Snow comes to be formed into the figure of Stars.

XI.
How the Flocks of Snow are formed into the Figure of Rose.

XII.
How the Flocks of Snow come to resemble Lilies.

To the Right Honourable William Wentworth Earle of Strafford, Viscount Wentworth, and Baron Wentworth Woodhouse, Newmarch, Oversley, and Raby, Knight of the Garter &c.

This Plate is humbly Dedicated by Richard Blome

XIII. *How some of these Snowy Stars come to be white, or pellucid.*

Some of these *Snowy Stars* are white, like refin'd *Sugar*; and others of them are Transparent. The *Whiteness* of them proceeds from the *Mediocrity* or *Temperateness* of *Heat*; as when it hath not force enough to pierce to the *bottom* of the *Matter* whereof they are compoſed. Or becauſe in their paſſage through the *Air*, they have joyn'd to themſelves ſome *particles* of *Water*, before they got down to the *Earth*. Whereas other *Flocks*, that are more thin and ſmall, are *tranſparent*; becauſe the *Heat* hath wholly penetrated them, and made their *particles* to come nearer, and to be joyn'd more cloſely together.

XIV. *How there comes to be a Point in the midſt of the Roſie-Snow.*

One thing remains ſtill to be noted, *viz.* that there is ſeen a *white Point* in the *Center* of the *Roſie-Snow*, as is repreſented in Q. The Reaſon whereof may be, becauſe the *Heat* that hath formed theſe *Stars*, is ſo moderate, that tho' it makes all their other *parts* pellucid; yet not being ſtrong enough to pierce to their *Center*, it leaves them *white*.

CHAP. XIX.

Of Thunder, Lightning, and Coruſcation, or Flaſhes.

I *Lightning and Coruſcation follow after Thunder.*

TO the end that the Nature of *Lightning* and *Coruſcation* may be the better underſtood, we muſt premiſe ſomething concerning THUNDER; for uſually they are Concomitants of it, and depend on it, as their *Cauſe*. Now *Thunder* is produc'd, when many *Clouds* ruſh down upon others that lye directly under them. For it comes to paſs ſometimes, that the higheſt *Clouds* being condenſed by *Heat*, and made more weighty, fall down upon others that lye under them, and cauſe that Noiſe which we call a *Thunder-Clap*. For it cannot be queſtion'd, but that in the *Summer time* eſpecially there are abundance of *Nitrous*, *Fat* and *Sulphureous Exhalations*, in the *Air*. It is certain alſo, that *Snowy Clouds* are condenſed by *Heat*, and thereby become more Heavy. It is alſo as apparent, that all *Clouds* are not of the ſame height, but ſome higher, and others lower; ſince beſides *Reaſon*, *Senſe* it ſelf comes to confirm it, which often ſhews us one *Cloud* moving over another. Theſe things being thus preſuppos'd, we proceed to the Explication of *Thunder*, *Lightning*, and *Coruſcation*.

II. *What is the Cauſe of Thunder.*

When any *Clouds* condenſed by *Heat*, and by this means being become more Heavy, ruſh down upon an *Inferiour Cloud*, the intermediate *Air* being thereby ſtrongly agitated, is the cauſe of a *dreadful Sound*, which is called *Thunder*. For let us ſuppoſe two *Clouds* A and B, compoſed of looſe and much dilated *Snow*; let us alſo ſuppoſe, that there is a warmer *Air* about the upper *Cloud* A, than about the lower *Cloud* B; it is evident, that for this Reaſon it muſt be more and more condenſed, and conſequently become more Heavy: So that its moſt outward *parts* falling down firſt, puſh others they meet with in their way, and hurrying them along with them, do at laſt ruſh down all together, with great Violence, upon the *Lower Cloud*, with a dreadful rumbling Noiſe.

Figure 55.

III. *Heat condenſeth the Clouds.*

I have ſaid, that *Heat condenſeth the Clouds*: For tho' *Heat* do rarefie ſome *Bodies*, yet it ordinarily is wont to condenſe *Clouds*, as hath before been ſaid of *Snow*, which conſiſts of the ſame *matter* as a *Cloud* doth. For if *Snow* be laid in a warm place, it contracts it ſelf into a leſs *Figure*, before that any *water* drop from it, or its weight be diminiſhed. The *Clouds* therefore being thus *condenſed*, do eaſily deſcend, and oppoſe the paſſage of others that moved upwards, by reaſon of their Looſneſs, and thruſt downwards whatſoever oppoſeth them in their way. And foraſmuch as this cannot be without a violent concuſſion of the *Air*, therefore it is accompanied with that terrible Noiſe, the reſounding *Air* making it ſtill louder. *denſeth the Clouds.*

IV. *What Thunder is.*

Thunder therefore is a Noiſe excited by the *Air*, which hath been intercepted between two *Clouds*, whereof the Upper falling upon the Lower, and which being forc'd to retire thence, by the weight of the middle part of the Upper *Cloud*, which continues to come down, forceth for it ſelf narrow and irregular *Gaps*, to get out by, which produceth a dreadful *Sound*, being much augmented by the Rarefaction cauſed by the enkindling of the *Nitrous Sulphurs* betwixt theſe 2 *Clouds*.

V. *Why Thunder is much more frequent in Summer, than in Winter.*

It *Thunders* but rarely with us in the *Winter* time, becauſe then the *Heat* that is ſufficient to diſſolve the Upper *Clouds*, cannot reach ſo far. But in the *Summer time*, when the *Heat* is violent, and more eſpecially when the *North-wind* makes the *Heat* to be more cloſe and ſtifling, *Thunder* is produc'd; becauſe this *wind* is wont to carry the *heated Air*, that is near the *Earth*, upwards, to thoſe higher *Clouds*; by which means not only thoſe Superiour *Clouds* are condenſed and ruſh'd downwards, but alſo the Lower continue ſo looſe and dilated, and by the Dilatation of the *Air* that is under them, are ſo thruſt upwards, that they, as it were, meet the others falling down upon them, and ſtop them there, hindring any part of them from coming down to the *Earth*.

VI. *Why every Clap of Thunder is commonly follow'd by a Shower of Rain.*

Thunder is commonly follow'd by a *Shower of Rain*, and when the *Rain* is very copious, it is a *ſign* that little more *Thunder* will follow; becauſe when the Force wherewith the *Upper Cloud* ruſheth down from the *Lower*, is ſtrong enough to make it come down wholly, the *Thunder* muſt needs ceaſe: And if it be not ſtrong enough, and the *Lower Cloud* diſſolves into *Rain*, the ſame thing will ſtill happen; becauſe the *Air* that is ſhut up betwixt the 2 *Clouds*, can now with eaſe get forth, becauſe of the ſmall reſiſtance of the *Lower Cloud* diſſolving into *Rain*.

VII. *The Noiſe of Bells conduceth to make Thunder ceaſe.*

The *Sound* of *Bells*, and of *Canons* diſcharged, makes *Thunder* to ceaſe; becauſe thereby the *Air* is ſtrongly agitated, and communicating its *motion* to the Neighbouring *Air*, and that again to the Intermediate, till it reach and ſhake the *Snow*, whereof the inferiour *Cloud* conſiſts, occaſions its deſcent. Which Experience makes evident to thoſe, who are us'd to Travel in thoſe *Vallies*, where the falling down of *heaps* of *Snow* from the *Hills* is apprehended; for fearing leſt the *Sound of their Voice*, by ſhaking the *Air*, ſhould bring down the *Snow*, they are afraid ſo much as to Cough, to prevent that danger.

VIII. *What is the Cauſe of Coruſcation.* The *Exhalations* that are found in that Space which is between the 2 *Clouds*, are the *matter* of *Coruſcations* and *Lightning*, and according to the degree of *Rarefaction* and *Condenſation*, produce either the one or the other: For *Coruſcation* proceeds from an abundance of very *ſubtil Exhalations*, and very inflammable. For theſe *ſubtil* and *ſulphureous Exhalations* in the *Air*, become kindled by this *Agitation*, by reaſon that the *Matter* of the *firſt Element* being by this Concuſſion deliver'd from its Bonds, doth moſt ſwiftly run through them, which is the Reaſon of thoſe *Flaſhes*. This does frequently happen after great *Heat* and *Droughts*; for then by the daſhing together of *Light Clouds*, a *Flame* is kindled and breaks forth, which often reacheth our *Eyes*, without the *hearing* of any Noiſe; becauſe the *Clouds* daſhing againſt each other, is too ſoft to be heard at ſo great a diſtance.

IX. *What is the Cauſe of Lightning.* But if the *Exhalations*, which are intercepted between 2 *Clouds* ruſhing againſt one another be thicker and cloſer, then with great vehemence breaking through the ſhatter'd *Clouds*, and obliquely darted down to the *Earth*, they conſtitute the *Lightning*; by which (according to the condition of its own *Matter*, which ſometimes is more thick, or groſs and copious, and therefore more Violent; and at other times, more ſubtil and in leſs quantity, and ſo more penetrative; or of the *matter* of its *Objects*, whereof the more hard and ſolid, do make a greater and ſtronger Reſiſtance, becauſe they cannot give way, and ſo are diſſipated by it: Whereas the *ſofter* and *porous Objects* do eaſily give way, but withal more readily take *Fire*) thoſe wonderful and ſtupendous Effects are produc'd, which ſtrike Mens *Minds* with Aſtoniſhment, and force the moſt impious *Minds*, tho' ſore againſt their wills, to revere the *Divine Power*.

X. *Of the Thunderbolt.* It is commonly believ'd, that beſides the *Coruſcation* and *Lightning* which proceed from the 2 *Clouds*, there comes forth alſo a hard *Stony ſubſtance*, which is called a *Thunderbolt*, tho' it is own'd that the ſame is not always diſcharg'd, as oft as it *Thunders*; but ſome think this is only aſſerted, and not proved. Yet if any ſuch thing ſhould be, we muſt ſuppoſe it to be generated of ſome groſs *Matter*, which in its deſcent, hath by the great *Heat* been reduc'd to that hardneſs.

XI. *How the Lightning differs from Coruſcation.* The difference between *Lightning* and *Coruſcations* or *Flaſhes*, is this: *Coruſcations* or *Flaſhes*, may be cauſed by *Exhalations* that lye under one *Cloud* only; whereas *Lightning* doth not proceed, but from ſuch *Exhalations* as are intercepted betwixt two or more *Clouds*. Becauſe *Lightning* is an *Exhalation* with a great force breaking through the *Clouds*, which cannot be, but by *Clouds* that lye one upon another, when by the heavy fall or ruſhing down of the upper *Cloud*, the *Exhalations* are kindled, and through a Breach made in the *Lower Cloud*, are darted downwards towards the *Earth*. We muſt conceive that the whole *Upper Cloud* ruſheth down upon the *Lower* equally and altogether; for then it *Lightens*, by reaſon of the kindled *Exhalations* breaking through the *Lower Cloud*.

XII. *The Definition of Flaſhing and Lightning.* For *Flaſhing or Coruſcation is* nothing elſe, but *an Exhalation ſpread under a Cloud, which by the motion of the ſaid Cloud ruſhing downwards, is ſet on fire, and flaſheth.* Much after the ſame manner, as a *Torch* newly put out, and yet *ſmoaking*, is by ſome violent and ſudden *motion* again enkindled. But *Lightning is an Exhalation intercepted between two or more Clouds, which by the Heavy Fall of the Superiour Cloud is not only kindled, but through the Lower Cloud is thruſt down to the Earth.*

XIII. *Why the Lightning commonly ſtrikes Mountains and the Tops of Steeples.* The *Lightning* doth more frequently ſtrike the Tops of the *Mountains* and *Steeples*; for ſeeing that the *Clouds*, where the *Thunder* is generated, are high, and that the breach is uſually made at the end of them; it cannot well be conceived, but that the *Exhalation* that breaks forth thence, ruſhing down ſlantingly, muſt needs meet with the higheſt *Bodies* firſt. To which we may add, That if 2 *Clouds*, whoſe Ends are ſeparate from each other, were to open in the Lower part of them, we muſt ſuppoſe that it would rather happen in that part which anſwers to the High *Body*; becauſe the ſame, by hindring the deſcent of the *Air*, doth determine it by its Reſiſtance, to break rather in that place, than in any other.

XIV. *The various Effects of Lightning.* The various Effects of *Lightning* are to be attributed to the compoſition of the ſeveral *Exhalations*. It burns the *Cloaths* or *Hair* of a *Man*, without touching his *Body*; becauſe the *Exhalations* whereof it conſiſts, is of the nature of *Oil*, whoſe flame is weak. Sometimes it melts the *Gold* that is in a *Mans Purſe*, and the *Sword* in the *Sheath*, without hurting the *Purſe* or *Sheath*; which happens, becauſe the *Exhalations* are very *ſubtil*, as participating of the Nature of *Salt* and *Aqua-Fortis*, by which means they paſs through *porous Bodies* without any Impediment or hurt to them; but diſſolve whatſoever reſiſts entrance. As we find much the ſame effect of *Aqua-Fortis*, which diſſolves the *Hardeſt Bodies*, and yet leaves *Wax*, and other *Soft Bodies*, in a manner untouch'd.

CHAP. XX.

Of the Rainbow, Circles about the Sun and Moon, and of Mock-Suns and Mock-Moons.

I. *The Definition of a Rainbow.* THE RAINBOW may be defin'd *a Bow of diverſe Colours, which the oppoſite Sun paints on Drops of Water by a various Modification of his Light.* It is called a *Bow*, becauſe it is repreſented in the *figure* of half a *Circle*. For the *Rainbow* is a portion of that *Circle*, which is drawn from that *Line*, as from its *Center*, which paſſeth from the *Sun*, through our Eye, called the *Axis Viſorius*. It is ſaid to be *of many Colours*; becauſe of the ſeveral *Colours* which may be diſcern'd in it. And laſtly, it is ſaid, That the *oppoſite Sun paints*, or repreſents it, *in Watry Drops*, theſe being indeed the *Matter* of a *Rainbow*.

II. *What things are to be noted in a Rainbow.* We ſhall the better be able to underſtand the nature of a *Rainbow*, by taking a view of all the particulars that are contained in it. *Firſt* then, we ſay that the *Rainbow* is repreſented in a *Dewy Cloud*. *Secondly*, That the *Dewy Cloud* conſiſts of innumerable drops oppoſite to the Sun. *Thirdly*, That

That every one of these *drops* are like a *Globe* of *Glass* filled with *Water*. *Fourthly*, That all and every one of these *drops*, being heavy, and consisting of *particles* of *water* joined together, are carried downwards. *Fifthly*, That the *Rainbow* is produced in such a manner in that part of the *Air*, which is opposite to the *Sun*; that the *Spectators* are in the middle between them, so that if a *line* drawn from the *Sun* to the *Eye* of the *Spectator*, should be continued, it would pass through the *Center* of the *Rainbow*, and consequently that the *Center* of the *Rainbow*, the *Eye* and the *Sun*, are placed in the same line. *Sixthly*. That the *drops* of *water*, illustrated by the *Sun*, must be *round*, and send back the *Sun-beams* from each part of their *surface*, either by *Reflexion* or *Refraction*.

III. *How many ways the Solar Rays may be transmitted to us from objects.*

To the end we may the better conceive, how the various *colours* of the *Rainbow* are represented to us, we are to presuppose that we can never perceive them, but when the *Sun shines*, whose *Rays* are either *reflected* to our *Eyes* from the *surface* of some *Opake Body*, or are transmitted to us by passing through a *Body* that is partly transparent, yet ting'd with some *colour* or other: Or, *Lastly*, They reach our *Eye* by passing through some *Diaphanous Body*, wherein they have met with some *Refraction*. For no other way can be imagined for *Beams* to come to us, besides one of these three. Now because these *Beams* which proceed to our *Eye*, from a *Dewy Cloud*, cannot be said to be reflected from an *Opake Body*, seeing it is not at all probable that any such can be so suddenly form'd in the *Air*: or any *Body* that is in some sort *Transparent*, but yet *coloured*, to send back the *Rays* of *Light* to us in such a manner as is necessary for us to see the appearance of a *Rainbow*: and that we find by experience, that when a *Rainbow* appears, the *Air* is full of *watry* or *dewy Drops*, which are transparent, without any *colour*; therefore we may with good ground conclude, that the *Rainbow* represents these *colours* to us, only by the mode or manner of the *Sun-beams* acting upon the *Drops* they pass through, and so suffering some *Refraction*.

IV. *There be many other things that represent the Colours of the Rainbow.*

This may be confirm'd by many Examples, as by *water* spouted out by *FULLERS* when they bedew and moisten their *Cloath*. In those *Bubbles* which *Children* make by dipping a *Straw* or other small *Pipe* in a Lather of *Soap* and *Water*. And in *Artificial Fountains* that cast up *Water* to a great *height*, which being there dispers't in the *Air* do exhibit the form of a *Rainbow* on these scatter'd drops, illustrated by the *Sun*.

V. *What are the Primary and Secundary Colours of the Rainbow.*

The chiefest *colours* are *Scarlet* or *Crimson Red*, which is seen in the utmost part of it; next to which is *Yellow*, the third *Green*, and the inmost *Purple* or *Violet colour*, or as others will have it *Blew*. I said that these are the chiefest *colours*, because by the mixture, passage and termination of these, many other *colours* arise. The foresaid *colours* are chiefly seen in the *Primary Rainbow*, which many times appears alone. But in the *Secondary Rainbow*, which is higher and more large than it, these *colours* are weaker, and turn'd the contrary way: for in it the *Purple* is the utmost *colour*, the next *Green*, the third *Yellow*, and the lowest *deep Scarlet*. And the same thing happens in a *Prism*, according as the same is beheld upwards or downwards, for accordingly the order of those *colours* appears inverted to us.

VI. *What is the Cause of the Colours in the Rainbow.*

As to the cause of these various *colours* that appear in the *Rainbow*, it will be sufficient for us to know that Light is nothing else but a certain action or *motion* of a *subtil matter*, whose *particles*, like so many *Globuli* or round *Pellets*, are conceived to roul through the *Pores* of *Earthly Bodies*; which *Globuli*, according to the variety of the *Causes*, which determin their *Actions* or *Motions*, are diversly moved. So that if we suppose them to be so determined, that they *whirl round* with a greater force, than they move according to a *Right Line*, they produce a *Deep Red Colour*: if they be not whirl'd about altogether so strongly they imprint the sensation of a *Yellow*. And on the contrary, if they be not whirl'd about so fast, as used to be at other times, when there is no such Cause to resist their *motion*, they produce a *Green colour*; and a *Blew* when they are mov'd much more slowly.

VII. *How these various Colours do appear in the Rainbow.*

How these *Colours* are produced, we shall easily apprehend, by exposing a *Globe of Glass* B C D, to the *Sun*; for then we shall see, supposing the *Sun* to shine in the part of *Heaven* A F Z, and the *Eye* placed in the point E, that the part D, of the *Bottle* or *Globe* of *Glass*, will be ting'd with a deep red *colour*. And that whether we bring it nearer, or remove it farther from us, the same *colour* will still appear to us, provided we keep the same station; and that the line D E, with the other E M, which we are to conceive drawn from the *Center* of the *Eye*, to the *Center* of the *Sun*, do constitute an *Angle* of about 42 *degrees*, for then the part D will be equally *coloured Red*. But if we should dilate this *Angle* a little, this *Redness* will disappear; and if we contract the said *Angle*, then will it not altogether vanish, but will first be divided into two parts less bright, in the which *Blew*, *Yellow* and other *colours* will appear. Figure 56.

Afterwards if we proceed and view the part of the *Glass Bottle* K, we shall observe, by making the *Angle* K E M, of about 52 *degrees*; that the said part K, will be likewise ting'd *Red*, but not so bright and lustrous as that of D; and that upon dilating the said *Angle*, as before, other *colours* will appear, but more weak and fading, and that upon our contracting the same, or by dilating the same much wider, they will wholly vanish.

From which instance we are plainly inform'd, that the whole space of the *Air* to M, being filled with such *Glass Globes*, or which is equivalent in this case, with *drops* of *Water*, some point of them must be ting'd with a *Red colour*; from whence the lines drawn to the *Eye* E, will with the line E M, constitute a line of about 42 *degrees*, such as we suppose those to be that are marked by the *Letter* R; and that these points considered altogether, without observing the *place* wherein they are, save by the *Angle* under which they are beheld, will appear like a continuous *Circle* of a *Red colour*; and so likewise that there must be some points in those *Drops*, which are at S and T, from whence *lines* drawn to E, will constitute somewhat more acute *Angles* with E M, by which the *Circles* of the more weak and fading *colours* are composed. And that in this the *Primary* or *Inward Rainbow* doth consist. Then supposing the *Angle* M E X, to be of 52 *degrees*, that a *Red Circle* must appear in

in the *Drops* at X, and other *Circles* of a leſs *deep colour*, in the *Drops* at Y; and that in this the *Secondary* or outward *Rainbow* doth conſiſt. And laſtly, that by all the other drops marked V, no *colours* at all are produced.

VIII. *A Primary Rainbow is repreſented in the drops, after two Refractions and one Reflexion.*

A *Primary Rainbow* therefore is produced by thoſe *Rays* which come to the *Eye* after 2 *Refractions*, and one *Reflexion*; whereas the *Secondary* is generated of the *Solar-beams*, reaching the *Eye*, after 2 *Refractions* and 2 *Reflexions*. For if we make a more accurate ſearch whence the *Red colour* proceeds, which appears in the part D, of the *Round Glaſs*, we ſhall find that it depends on the *Sun beams* (which we look upon as ſo many *parallel lines*, becauſe of the vaſt diſtance of the *Sun* from us) which coming from A, to B, entring the *water*, are *refracted* in the *point* B, and go on to G, whence being *reflected* to D, and there coming out of the *water*, and a ſecond time *refracted* tend to E. For as ſoon as any *Opake Body* ſhall be oppoſed to any of the *Lines* A B, B C, C D, or D E, immediately the *Red colour* will diſappear; and tho' we ſhould darken the whole *Ball* of *Glaſs*, excepting only the 2 *points* B and D, and ſhould round about beſet it with *Opake Bodies*, provided nothing do hinder the *Action* of the *Rays* A B C D, yet the ſame will ſhine brightly. Afterwards having in the ſame manner ſearched out the *Cauſe* of the *Red colour* appearing in K, we ſhall find that the ſame depends on the *Solar Beams*, which coming from F to G, are there *refracted* towards H, and in H, *reflected* to I, and again from I, *reflected* to K; and laſtly being again *refracted* in the *point* K, tend towards E. And therefore a *Primary Rainbow* is repreſented in a *Dewy Cloud*, or in the ſeveral *drops* oppoſit to the *Sun*, after 2 *Refractions* and 1 *Reflexion*; but the *Secondary* after 2 *Refractions*, and as many *Reflexions*.

IX. *It always rains in that place where the Rainbow appears.*

If any object that *Rainbows* ſometimes appear in thoſe places where there falls no *Rain* at all; and therefore they do not always proceed from thoſe Cauſes we have here aſſigned to them. I anſwer that a *Rainbow* is ever repreſented in *Rainy Drops*, and that they never appear but in *rainy weather*; for the *Rainbow* is an individual companion of *Falling Rain*, tho' poſſibly it may not rain in that place from whence the *Rainbow* is ſeen, yet ſure it is that it muſt rain in that place where it appears.

X. *Rainbows appear variouſly according to the different poſition of the Spectator.*

Tho' a *Rainbow* be viſible to all, yet it is not ſeen by all after the ſame manner: For ſeeing that the *Drops* which appear ſtain'd with ſome *colour*, are perceived about the *Axis Viſorius*, under a certain *Angle*, and that all *Spectators* have a different *Axis*, it follows that every one of them muſt have his peculiar *Rainbow*. Yea, if the ſame perſon chance to go back, or forward, only ſome few ſteps, he will not behold the ſame, but ſtill a different *Rainbow*; ſeeing that the *Drops* of *Water*, are for example, repreſented under a certain *Angle* of *Refraction*, as the ſaid *Angle* is enlarged by going forwards, or diminiſht by going backwards, the *Rays* of *Light* will be variouſly returned, and will make a different *Rainbow*. So that there are as many *Rainbows*, as there are places, from whence they are beheld; wherefore it is no wonder what the Proverb ſaith, *that the Rainbow flies from thoſe that follow it, and follow thoſe that flee from it.*

XI. *What Halos are, and wherein they agree with the Rainbow.*

HALOS, or the *Circles* which appear about the *Sun* and *Moon*, are much of the ſame nature with the *Rainbow*. For they are round like the *Rainbow*, or approach to it, and have always ſome *Star* for their *Center*; for how ſwift ſoever the *Stars motion* may be, it is always found in the *Center*; which is a manifeſt Argument, that theſe conſpicuous *Circles* or *Crowns* are produced by *Reflexion* or *Refraction*. They agree alſo with the *Rainbow* in this, that they are of various *colours* like it; whence we muſt conclude that *Refraction*, and a ſhadow that may terminate the *Light*, are neceſſary to the Production of theſe *Circles*.

XII. *How theſe Ciroles differ from a Rainbow.*

Yet theſe *Circles* differ alſo from a *Rainbow*, becauſe a *Rainbow* is never ſeen but in *rainy weather*, tho' it be not neceſſary that it ſhould always rain where the *Spectator* is. Whereas theſe never appear in *rainy weather*, which is a plain argument that they are not generated by *Refraction* made in the drops of *water*, but by that which is made in the *particles* of *Ice*, found in the *figure* of *Stars*; for we cannot meet with any other Cauſe to which we may aſcribe this effect.

XIII. *How theſe Circles are formed in the Clouds.*

When therefore at any time there be *Clouds* in the *Air*, of a moderate thickneſs, the *Light* of the *Sun* or *Moon*, piercing the little *particles* of *Ice*, whereof they are compoſed, becomes refracted in ſuch a manner, that not being viſible ſave only to a certain diſtance from thoſe *Stars*, it produceth the appearance of ſeveral *colours*, *viz. Red* on the ſhady ſide, and *Blew* or *Purple* on the ſide toward the *Sun* or *Moon*.

XIV. *A further Explication how theſe Circles are formed about the Stars.*

As for example, when the *Beams*, proceeding from the *Sun* or *Moon* A B C, darting againſt a *Heap* of *Icy Stars* G E F, lying upon one another, are *refracted*, and reach the *Eye* of the *Spectator* D. For if the *Beam* proceeding from the point A, to the end of the *Icy Star* G, and the *Ray* from the point C, to the end of the little *Star* F, be *refracted* towards D, it is plain, that beſides the *Beams* A D, and C D, and ſuch like, which paſſing in a *right line*, do repreſent the *Sun* or *Moon* in their proper form; others being refracted in E E, will make the *Air* comprehended in this *Circle* F F, very Bright, and repreſent its *circumference* betwixt the *Circles* E E, and G G, in the form of a *Crown* or *Circle* diſtinguiſht with the *colours* of the *Rainbow*. So as that the *Red colour* will appear on the inſide about F, and a *Blew colour* on the outſide at G. Figure 57.

XV. *How thoſe Circles are produc'd in which Mock-Suns are formed.*

There are likewiſe other *CIRCLES* formed in the *Clouds*, but very different from thoſe we have now mentioned: becauſe they appear only of a *White colour*, nor have they any *Star* in their *Center*, as the *Circles* or *Halos* have; but for the moſt part paſs through the *Centers* of the *Sun* or *Moon*, and ſeem to be altogether, or almoſt *parallel* to the *Horizon*. And theſe are only ſeen in Great and Round *Clouds*, covered with *Ice*, in which *Mock-Suns* are repreſented by means of *Reflexion* or *Refraction*. For the *Sun* darting its *Beams* againſt a *Snowy Cloud* that is covered with *Ice*, and from the *Ice* reflecting into the *Snow*, muſt repreſent the ſame to the *Eyes* of the *Spectators* ſtanding on the *Earth* under it, in the form of a great *Circle*. Hence it is that theſe *PARHELIA* are called *Mock-Suns*, *becauſe they are reflected re-*

pre-

XI. What Halos are, and wherein they agree with the Rainbow.

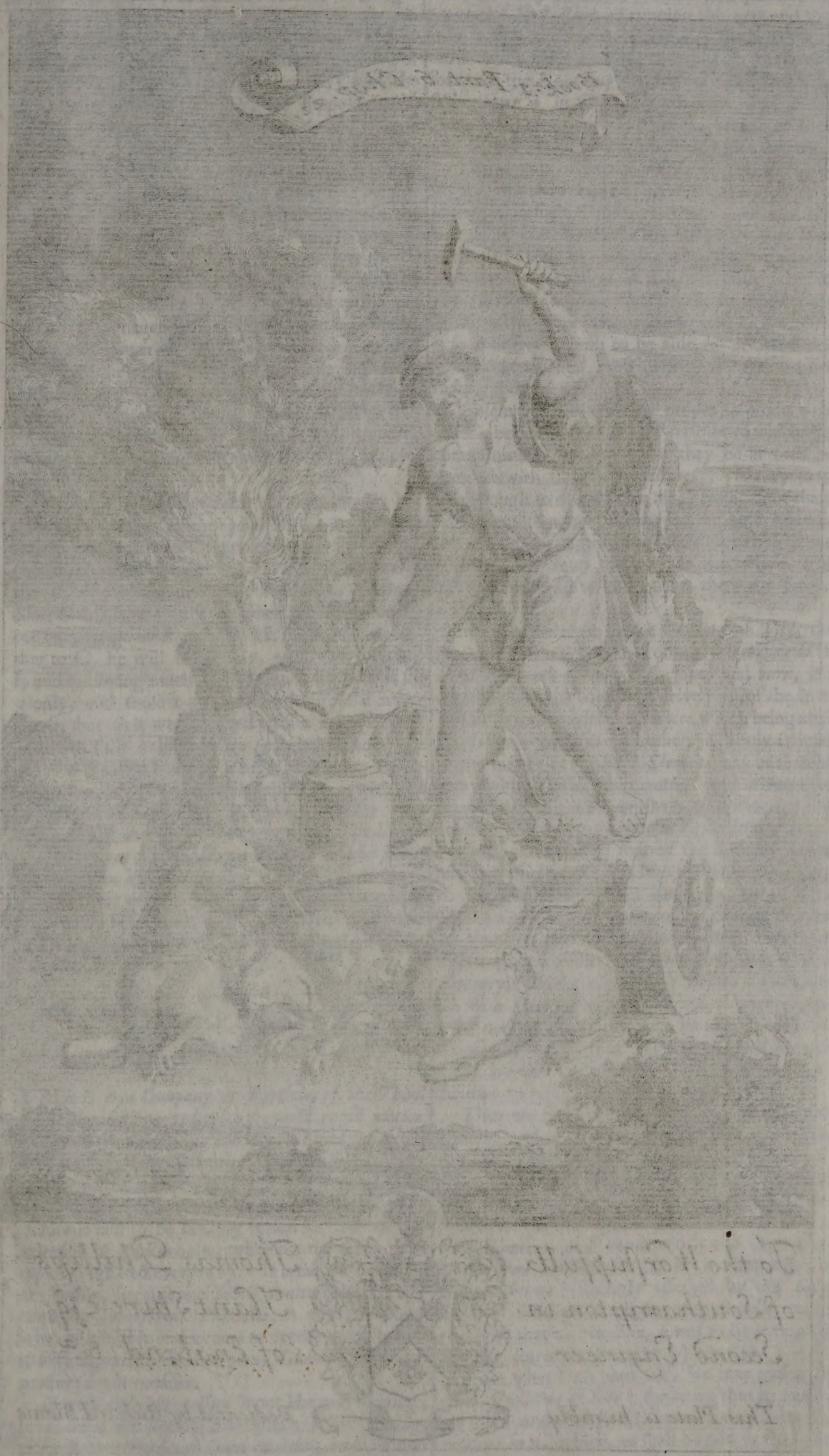
XII. How these Circles differ from a Rainbow.

XIII. How these Circles are formed in the Clouds.

XIV. A further Explication how these Circles are formed about the Stars.

Figure 57.

XV. How these Circles are produc'd in which Mock-Suns are formed.



To the Worshipfull Thomas Phillips
of Southampton in Hant Shire Esqr
Second Engineer of England &$^{c.a}$

This Plate is humbly Dedicated by Richard Blome

presentations of the true Sun in a Cloud, as Images in a Looking Glass.

XVI. *How six Suns may be seen in this Circle.* In such a *Circle* as this, there sometimes appear 2 *Suns*, sometimes 4, yea and sometimes 6. For let D E F G H I, be a great and round *Cloud*, the upper part whereof D E F, we suppose to be thicker, as being more exposed to the *Wind* and the *Heat* of the *Sun*. The *Sun* being sufficiently High to the *South* A, and the *Eye* of the *Spectator* K, 6 *Suns* may appear in this *Circle*: The *first* and chiefest at E, by *Beams* proceeding from the *Sun* A, at right *lines*: the *second* and *third* at D and F, *by refracted Beams*, that penetrate the *Ice* in those places; where its thickness decreasing by degrees, they are on both sides crooked or bent inwards. Whence it is that these two *Suns* cast a *Red Colour* towards their Circumference, on that side where they look towards E, where the *Ice* is thicker; and a *Blew Colour* on the other side, where it is more thin. The *fourth* at H, is seen by directly *reflected Rays*: And lastly, the *fifth* and *sixth* G and I, by *Rays reflected* to equal *Angles*.

Figure 58.

XVII. *How it happens that less than six Suns are seen.* But in case the *Spectator* be not at K, but somewhere nearer to the *point* B, so as that the Circle, whose *Center* is supposed in his Eye, and to pass through B, do not cut the Circumference of the *Cloud*; then will not he be able to see the 2 *Suns* G and I, but only the other 4. And if on the contrary he go back much to H, or somewhat further to C, he will see 5 only, *viz.* D E F G and I, and removing much more backwards, he will see 3 only, and those 2 not contained within a *white Circle*, but as it were pierced with a *white Cloud*.

XVIII. *What a Mock-Moon is.* When such a like *Image* is beheld under the *Moon* it is called *PARASELENE*, that is, a *Mock-Moon*, which admits of a like application with that of the *Mock-Suns* already spoken of; for as a *Mock-Sun* is the Image of the *Sun reflected* in a *Cloud*; so is a *Mock-Moon an Image of the Moon appearing in a Cloud*. Such were those which appeared in the year 1671, the 25*th* of *May* about 11 a *Clock* at *Night*, when the *Moon* was very much declined towards the *South*, and near the *Horizon*.

CHAP. XXI.

Of Fire.

I. *What Fire is.* *FIRE is a Company of Particles of the Third Element, moved with the most rapid motion imaginable.* Or, it is a *Lucid* and *Fluid Body*, consisting of *Earthly Particles*, most swiftly moved by the matter of the *First Element*, upon which they swim, as it were.

II. *Why Fire is said to be hot and shining.* *Fire* is said to be *hot*, by reason of the various agitation of its *Particles*, whereby they are most rapidly agitated every way. It is said to be *Lucid* or *shining*, because the *subtil matter*, which agitates the *Terrestrial Particles*, is whirl'd round, whence whilst it endeavours to recede or withdraw it self, it presseth the *Heavenly Globuli*, in which pression *Light* consists.

III. *The variety of Fire.* Nevertheless every *Fire* is not *Hot* and *Shining*; for there is one sort of *Fire* which is only *shining*, as in *Rotten Wood* and *Glow-worms*; and another sort which is *hot* only, as in *Dung*, and a third sort that is both *hot* and *shining* together.

IV. *What is the Cause of these various Fires.* *Fire* is only *shining* when the most *subtil matter* of the *First Element* running this way and that way in the strait *pores* of *Earthly Bodies*, which resist the entrance of any other matter, doth push forwards the *Heavenly Globuli*: or else when the said *matter* is in so small a quantity, that it can only press the *Cœlestial Globuli*, which of their own nature are sufficiently incited to *Motion*, without being able to agitate the *Terrestrial Particles*. Again, the *Fire* will be only *hot*, when the *subtil matter* is in such abundance, that it can also agitate those *Earthly Particles*, but yet withal is so entangled with the *Earthly* and *Watry Particles*, that it cannot explicate it self, nor push forwards the *Heavenly Globuli* every way, in a *right line*. And Lastly, *Fire* is both *shining* and *hot*, when it is so at liberty as both to be able to press the *Heavenly Globuli*, and most swiftly to move the *Terrestrial Particles*.

V. *Violent Motion produceth Fire.* Violent *Motions* are very proper to produce this effect, because the *Earthly Particles*, to which they communicate themselves, tho' they be at first encompast with the *Second Element*, yet they move fast enough to drive them away from about themselves, and to admit nothing but the *First Element*, which much augmenting their agitation, doth dispose them soon to separate themselves from one another, and to take upon them the form of a *Flame*.

VI. *Fire is kindled by driving out the Globuli from the Intervals of the Terrestrial Particles.* In order therefore to the *kindling* of *Fire*, that is, to the gathering such store of the matter of the *First Element*, as may both *shine* and *burn*, it is necessary that the *Globuli* be driven out of the Intervals of some *Terrestrial Particles*, which being afterwards separated from each other, and only swiming in the matter of the *First Element*, may be snatched away with its most swift *motion*, and driven every way. That this is so, we shall easily conceive, if we consider that the matter of the *First Element* doth in swiftness much exceed that of the *Second Element*, and that those little *Bodies* which swim amongst the *particles* of these 2 Elements, can only be carried along by the motion of the *Second Element*, for that its *Globuli* do break the force of the *First Element*, and resist its *motion*: whereas on the contrary, whilst those *Earthly Bodies* are surrounded with the matter of the *First Element*, they must necessarily comply with its agitation, in like manner as we see that a piece of *wood* is carried away by the swiftness of the stream wherein it *swims*.

VII. *Whence it is that the Brightness of a Flame is greater in a dark than in a light Place.* Thus we find that the *Brightness* of a *Flame* is greater, and more conspicuous in a dark *Place*, than in one enlightned by the *Sun*; because in a place so illustrated, many *Globuli* of the *Second Element* from the *Sun*, are sent into the *Flame*, which lessen the agitation of the *matter* of the *First Element*, and consequently also the violence of the *Fire*. Whence also it is that when our *Optick Nerve* is strongly affected by the *Fulgid Light* of the *Sun*, the light of a *Candle*, compared with that of the *Sun*, seems to be none at all, as being scarcely discernable by our *Eyes*.

VIII. *Why Fire is hot and shining.* From what hath been said, we may gather the chief *Qualities of Fire*: for seeing that its *particles* are solid, and most swiftly moved, they cannot but produce *heat*, which, as shall be said in the following *Chapter*, is nothing else save *the actual various motion of the little parts of the Body*, affecting

the *sense* of *feeling*. And so also if together with this we call to *mind*, what before hath been said concerning *Light*, *viz.* that it consists in an endeavour of receding from the *Center*, or in the pressure of the *Heavenly Globuli*. For seeing that the subtil matter, that constitutes *Fire*, is constantly whirled round, and endeavours to recede thence, it cannot but procreate the sense of *Light*, and make the *Fire Bright* and *Shining*.

IX. *Of the several ways whereby Fire may be kindled.*

Fire may be kindled several ways: *First* out of *Flints*, for they being of a hard substance, if other *stiff Bodies* dash against them, by this means the *Globuli* of the *Second Element*, because of the narrowness of the interjected space, are forced to march off, leaving only behind them the matter of the *First Element*, and so the *Earthly Particles* which swim upon it, and follow its *motion* produce *Fire* and are turned to *Sparks*. Which may be the Cause why we find that in *Subterraneous Places Fire* is often kindled. For since there is always in those places a *viscous slimy matter*, and many *exhalations* are sublimed there by the *Suns heat*, it may so happen that one *Flint* dashing against another, may send forth *sparks*, by which the *exhalations* that cleave to the kindled *viscous* or *sulphureous matter*, may communicate a *flame* to the *Bodies* that are neareſt to them. Now that there are such fat and *sulphurous Flames* in the *Bowels* of the *Earth*, is well known to the *Miners*, and Reason evinceth the same; for seeing that there is a *Fire* in the *Bowels* of the *Earth*, there must be *Fumes* arising from it; seeing also that there are *sulphurous hot Bathes*, and *veins* of *Jews Lime*, and other oily *matter* boyling in the hidden Channels of the *Earth*, we may easily judge that from these also a continual *Smoak* or *Fume* must proceed by way of *exhalation*. And it seems probable, that the first kindling of those *Fires* which burn in *Mount Ætna* in *Sicily*, and *Vesuvius* in *Campania*, hapned after this manner.

X. *How Fire is kindled by a Burning Glass.*

There is also another way of *kindling Fire*, *viz.* when the *Beams* of the *Sun* are concentred in a *concave Glass*, for by this means the *Globuli* acting with their joint forces, do excite a various and vehement excitation of the *Terrestrial Particles*, whence proceeds a *Flame*, the *Heavenly Globuli* being beaten back, by the swift agitation of the *Terrestrial Particles*, so as that the *Particles* of the most *subtil matter* can freely flow together and continue this agitation.

XI. *Sharp Spirits can also kindle a Fire.*

A *Fire* also may be kindled by *sharp Spirits*, as appears in *Hay*, which if it be laid up before it be sufficiently dry, it becomes hot by degrees, and at last breaks forth into a *Flame*, because the *Spirits* of *Herbs* that are shut up in it, have not so free an egress, as when they were *Green*, and before they began to be dried; and therefore being no longer able to enter into the same passages, with the *Globuli* of the *Second Element*, they become surrounded only by the matter of the *First Element*, which putting them into a most swift *motion*, makes a *Flame* to appear. But this never happens in *Wood*, tho' it be struck never so much, because its *substance* is not stiff enough, that by a *concussion* of another *hard Body*, the *Globuli* of the *Second Element* should be driven away, because the part that is struck bends towards another, before that the Second begins to bend towards the Third, and that again towards those that are next to it, by which means its force of flying back is lost.

XII. *How Fire is Nourisht or Fed.*

But forasmuch as *Flame* is perpetually turn'd to *Smoak*, and is no more the same than a *River*, which is continually supplied by an access of new *waters*, it is of absolute necessity that it have some *Food* or *Fewel* whereby it may be preserved and maintained. And this is no other but those *Terrestrial Parts*, which being agitated by the *matter* of the *First Element*, have a power to drive away the *Air* or any other *Body*, that might extinguish it. It is also requisit that these *particles* be very *thin*, that they may be able to supply the room of the vanishing *Smoak*: for the thicker *particles* are easily surrounded by the *Globuli* of the *Second Element*, and possessing themselves of the places which the *particles* of the *First Element* have left, do much break the force of the *Fire*, and choak its *Flame*.

XIII. *Oily and Sulphurous Bodies are a proper fewel to preserve Fire.*

For which reason also all *Oily*, *Sulphurous* and *Bituminous Bodies* are of all others most conducive to maintain and preserve *Fire*; for that by reason of the contexture of their *Branch-like* Parts, and their fit *Thickness*, they are most fit and disposed to be agitated by the *particles* of the *First Element*, and being thereby driven out of their places, to communicate their *motion* to other *Bodies* with such force as that they drive away the *particles* of the *Second Element*, which otherwise would extinguish the *Fire* into which they strive to enter on every side.

XIV. *How Flame is produced.*

These things premis'd, it will be easie to conceive, that *Flame* is nothing else but a *Fire* wholly at liberty, that is, a *Fire* whose parts are so agitated, that they entirely separate themselves from each other, and do only swim in the matter of the *First Element*. It will be likewise readily conceived how a *Flame* is produc'd, by viewing the *Candle* A B, and *reflecting* that there be many parts of *Wax* that move very swiftly throughout the whole space C D E, where they constitute a *Flame*, because they swim alone in the *matter* of the *First Element*. We must also consider, that the parts of *Wax* that constitute the *Flame* do continually strive to mount still higher, for that by reason of their great agitation they are more light than the *Air*, that surrounds them, which having been forced to descend continually, endeavours to return to its place again, and to which indeed it would return, if the new *particles* of *Wax* that come forth from the Wick, and which begin to follow the Course of the *First Element*, did not hinder it; which is confirmed by experience, which shews us that as soon as the *particles* of *Wax* cease to proceed thence, or tho' they do, yet have not force enough, the *Flame* ceaseth in the space C D E, and the *Air* possesseth it self of its place. Figure 59.

XV. *Why the Flame always mounts upwards, and ends in a point.*

It is peculiar to *Flame* to mount upwards, and to end in a *sharp point*: the reason whereof is, because the *Flame*, by reason of the great abundance of the matter of the *First Element* that is in it, being lighter than the *Air* that surrounds it, must of necessity tend upwards: and because the middle parts of the *Flame* G D E, are more strongly agitated by means of their greater solidity, than those which are about the utmost parts C C, whose *motion* is much diminisht by the neighbouring *Air*, this makes the *Flame* to *end in a point*, and its *Smoak* to break forth chiefly at the top H, where the

the *Terreſtrial particles* begin to loſe their agitation. As for Example, When the *Smoak* aſcends towards H, it makes the *Air* to deſcend by I and K, towards B, where razing the *Wick*, it puſhes the *particles* of *Wax* towards the *flame*, which ſerve to nouriſh it: Which Circular motion of the *Air* towards the *flame*, Experience ſhews us, in that when a *Chamber* is cloſe ſhut, ſave only ſome little Hole or Chink, and a *Fire* be kindled in it, a *Wind* is perceived to enter in by the ſaid Chink; and which is ſo much the ſtronger, by how much the *Fire* is greater.

XVI. *The force of Fire upon Earthly Bodies.*

Fire is extreamly *active*, and exerts its Force upon the *hardeſt* Bodies; for its *Particles*, as ſo many ſharp *Needles* penetrate their *Pores*, and driving out the *particles* therein contained, they divide its *parts*, and turn them into their own Matter; and in caſe the *particles* of the *Bodies*, the *Fire* acts upon, are eaſily ſeparable, then they *melt*. For to be *melted*, or in a *liquid* form, imports nothing elſe, but that the *Body* in that ſtate conſiſts of *Particles* that are divided from each other, and in ſome agitation. As on the other hand, *Bodies* are *dried*, when by approaching to the *fire*, their thin and ſlippery *Particles* are exhaled, the more thick Parts being left, which being thereby more cloſely joyn'd together, conſtitute *hard Bodies*.

XVII. *The Ventilation of the Air is neceſſary, to the preſervation of Fire.*

The *Ventilation* of the *Air* is neceſſary to *Fire*; becauſe the *Air* being puſh'd upwards by the mounting *flame*, cannot enter into another place, which the *Fire*, by conſuming its Fewel, leaves open for it; and whilſt it thus ſucceeds, it like a *Fan* or *Bellows*, drives the *fire* into the more inward parts of the *fewel*, and diſſipating thoſe that are more Heavy, doth thus by blowing preſerve the *fire*: For where this is not, and the *Air* is hindred from ſupplying the ſaid place, the *flame* not being able to give way, becomes choak'd by the more heavy and groſs *Fumes*.

XVIII. *Fire is extinguiſh'd by any Liquor poured upon it.*

Fire is put out, when any *liquor* or *moiſture* is poured upon it in a greater quantity, than can be put into motion by the force of the *fired Particles*; which is the Cauſe why a little *Water* increaſeth the *Fire*, whereas a great deal of it doth put it out.

XIX. *Why the Air muſt have free acceſs into a Chamber, that the Fire may not fill it with Smoak.*

Hence it is, that when a *Fire* is kindled in a *Chamber*, if the *Air* hath no free acceſs to it, the whole *Chamber* becomes preſently fill'd with *Smoak*. Becauſe the *Air* drives away from it great ſtore of *Air*, together with the *Particles*, of combuſtible *Bodies*: For it is theſe that being mix'd with the *Air*, conſtitute the *Smoak*, as the more ſolid Parts of thoſe *Bodies* are turn'd to *Aſhes*. And ſince it is repugnant that there ſhould be any *Vacuum* in Nature, it is neceſſary that ſo much *Air* enter the *Chamber*, as there is *Smoak* going out: For except this be, the whole *Chamber* will be fill'd with *Smoak*.

CHAP. XXII.

Of the Nature of Heat and Cold.

I. *Heat and Cold do not belong to any ſpecies of Quality really diſtinct from the Subject.*

HAving already rejected all *Qualities* really diſtinct from their *Subjects*, we ſhall not trouble our ſelves with the enquiry, to what Species of theſe Qualities, *Heat* and *Cold* do belong. And the rather, becauſe theſe *Forms* are unknown to us; and if we ſhould admit them, the Enquiry will ſtill remain, by what Virtue they operate, if they be *Active*; and how the Senſe ſuffers by them, if they be *Patible*. Wherefore it remains only for us to determine, to what *General Head* of things *Heat* and *Cold* do belong; *viz.* Whether they be *Subſtances*, or are only to be accounted amongſt the *Modes* of *Subſtances*.

II. *Wherein the Nature of Qualities in general doth conſiſt.*

Qualities that belong to Matter are nothing elſe, but certain diſpoſitions in the *Subjects*, conſiſting in *Magnitude*, *Figure*, *Motion* and *Situation* of *Parts*, whence they produce ſeveral ways of Senſation: Tho there be nothing in theſe *Bodies* like to thoſe *Idea's* they awake or excite in us; ſo that tho' the *Particles*, for Example, of an *Hot Object* be otherwiſe diſpos'd than thoſe of a *Cold*, yet in neither of them is there any thing like to thoſe *Idea's* or *Modes* of *Senſation* they ſtir up in us.

III. *Qualities are certain Modes in Bodies.*

If any one therefore enquire, whether theſe *Qualities* are *Modes* exiſting in *Bodies*? We Anſwer that they are ſo, if they be taken for the various diſpoſition of *Parts*; but not ſo, if they be taken for thoſe *Modes* of *Perception* which they excite in us.

IV. *What Heat and Cold is.*

Heat therefore is a *Quality ariſing from a greater and unequal Motion of the Terreſtrial Particles*: And *Cold* is a *Quality proceeding from the quiet of the Parts, or at leaſt from a leſs degree of Motion in them.*

V. *Heat conſiſts in Motion, and Cold in Reſt.*

We aſſert therefore, That *Heat* is nothing elſe, but the *motion* or *agitation* of the ſmall *Parts* of a *Body*; and *Cold*, their *reſt* or *conſiſtence*. Now that *Heat* is nothing elſe, but *motion*, may be proved from its Increaſe and Decreaſe; for we find that *Liquid Bodies* become hot, when their *Particles* are put in *motion* by *Fire*. Thus we find that *boyling Water*, *melted Metals*, and all other things, when ſet on *fire*, are very much agitated, neither is *heat* to be perceived in them, till their *Parts* be put in *motion*. In *conſiſtent* or compact *Bodies* we likewiſe find, that when they are ſtruck or rub one againſt the other, provided it be done with ſome Force, (as when two pieces of *Wood* are rub'd againſt each other, or a *Knife whetted* upon a *Whetſtone*) *heat* is excited in them both. For the *Heat* in any *Body* becomes increaſed, and grows ſtronger, by how much the *agitation* is greater. Hence it is, that nothing, amongſt *Natural Bodies*, is more hot than *Flame* is, becauſe nothing hath its *Parts* more agitated, as daily Experience teacheth. And if there appear any difference between one *Flame* and another, that proceeds only, becauſe the *Parts* whereof they are compoſed, are more or leſs *thick*; and conſequently more or leſs powerful to agitate thoſe *Bodies*, on which they exert their Forces.

VI. *All the Particles of Fire are moved, but not the whole Fire it ſelf.*

When we ſay, That *Heat* is *Motion*; we are not ſo to be underſtood, as if the whole *Body* that is *heated* were agitated: For it is repugnant that the ſame *Body*, ſhould at one and the ſame time be moved by various *Motions*; but only that the ſmall *particles* thereof be in *motion* and variouſly agitated; that is, that they change their *ſituation*, and are differently apply'd to the different *parts* of *ambient Bodies*, ſo as to be toſſed with various determinations, to the Right, to the Left, Upwards, Downwards, Forwards and Backwards, according to their ſeveral diſpoſitions and *figures*.

If

VII. *In what sense Liquid Bodies are said to be hot.*

If any one Object, That according to this Explication it will follow, that all *Liquid Bodies*, as *Water*, *Wind*, *Air*, and the like, are *hot*; because, as hath been said in our *General Physicks*, their *parts* are variously moved. For *Water* is no other ways distinguish'd from *Ice*, but because its *parts* are in continual *motion*; whereas those of *Ice* continue always in the same situation.

VIII. *The Answer to the foregoing Objection.*

Before I come to give a satisfactory Answer to this Difficulty, I would have it noted, that every *agitation* cannot be called *Heat*, but that only which is of force enough to affect the Sense of *Feeling*, and to shake the *Filaments* of our *Nerves*: For if the *motion* be not strong enough to produce this effect, we cannot give it the Name of *Heat*; that being an *Appellation*, which is attributed to things with relation to our *Senses*. Thus when a *Sound* is so weak, as not to reach our *Ears*, tho' it may wave the *Air*, it cannot be called a *Sound*. And so to denominate any thing *hot*, it is requisite that there be such a *motion* of the *Particles*, as to affect the *Nerves* of our *Hand*, or some other part of our *Body*. *Fluid Bodies* therefore, consider'd in themselves, and without any respect to our *Senses*, may be called *Hot*, tho' not *comparatively*, that is, with reference to our Sense of *Feeling*; except it should happen, that the *Particles* of our *Hand*, which is the ordinary *Organ* of *Feeling*, be more slowly moved than the *Particles* of the *Body* that is *felt*: As it happens, when with a *hot Hand* we touch a *Body* that is *Lukewarm*, which then feels *cold* to us; and yet we shall feel the same *Body* hot, if we apply our other *Hand* that is cold. *Water* therefore absolutely consider'd, may be said to be *hot*, because it contains some *heat* in it self, and is capable of being more *cold* by many degrees, as when it begins to *freez*: But with regard to our Sense it is *cold*, because it excites no such Sensation as we call *Heat*, in our *Organs*.

IX. *The Nature of Cold consists in Rest.*

Having discover'd the *Nature* of *Heat*, we cannot be ignorant of that of *Cold*: For as *Heat* is the various agitation of the insensible *parts* of a *Body*; so *Cold* is their *Rest*, or at least a diminution of their *Motion*. For we find by daily Experience, that *Hot-water* grows by so much the *colder*, as the Agitation of its *parts* ceaseth, till at last, by a total Cessation thereof, it be changed into *Ice*, which of all others is the most *cold Body*. Thus the things that are said to be *cold*, are endued with little or no Agitation, and consequently are not able to move our *Senses*, but rather moderate and put a stop to the *motion* of our *Animal Spirits*. Thus, as long as our *Fingers* are warm, we can do any thing with them; but when once they are seiz'd with *cold*, they become useless to us in the performing of any work.

X. *Why hot things take up more place, than such as are cold.*

A *Hot thing* therefore differs from a *Cold thing*, as a thing that is at rest or less moved, differs from that which is *moved*, or more swiftly moved. Whence it is that those *Bodies*, whose Parts are agitated by *heat*, contrary to their Custom, cannot be comprehended in so small a space or room, as those which are at rest, or are less moved; forasmuch as by means of this *motion* their small *particles* are rendred *irregular*, which therefore require more room, than when they are united, and are not separated by any agitation.

Some suppose *Cold* to be nothing else, but a *Privation* of *Heat*; but these seem not to have understood the Nature of *Rest*; which is nothing else, but *an abode in the same situation*: Now *Abode* or Continuance, is something *Positive*, yea, more *positive* than *motion* it self. For that which is unchangeable, must without doubt more partake of the Nature of an *Entity*, than that which consists in continual Change and Vicissitude. Wherefore we must conclude, that *Rest* or *Quiet* is a positive *thing*, as having no less efficacy than *Motion*. For which of the two shall we reckon to be most positive; that which keeps together and preserves other *Bodies*, or that which dissipates and destroys them? Now it is the Property of *Rest* to preserve many things, that by *Motion* are spoil'd and damnified: Wherefore *Rest* ought to be look'd upon as being more positive than *Motion*. For who will assert, that *to abide in a place*, *to continue in time*, *to rest in a Seat*, or the like, which belong to *Rest*, to be less positive, than *to take a Journey*, *to run a Race*, or *to be in a continual flowing*, which belong to *Motion*? Indeed it is an Error of our Mind, whereby we take *Rest* to be something *Privative*, and *Motion* to be *Positive*; because we experience, that the one depends on our *Will*, whereas the other is scarcely taken notice of by us.

XI. *Cold is something that is Positive.*

It seems strange to some, that by *Rest* only, which constitutes the Nature of Cold, *Rivers* and *Seas* should be *frozen*, and the Life of *Animals* should be destroy'd: And yet it is evident, that all this is done by *Rest* alone, not the least of *Motion* being to be found in any of these Effects. For what doth the *freezing* of *Rivers* and *Seas* import, but such a union and clinging together of their *parts*, whereby they do consist and are at *rest*? For no stronger *Argument* can be alledg'd to prove, that any *Bodies* are joyn'd, than to say that they lye at *rest* together.

XII. *It is by Rest alone that Rivers are frozen, yea, the Sea it self, and that Living Creatures die.*

XIII. *The parts of Ice are at Rest, tho' the whole may be carried along by the stream of the River.*

For tho' a whole *Body* of *Ice* may be carried along the *Water*, yet its Parts notwithstanding are at Rest together; for in case they were in agitation, then would they no longer constitute *Ice*, but *Water*; as we find, that when the *Frost* breaks, the parts of the *Ice* that lay still together before, by being separated through *motion*, turn to *Water*.

XIV. *Cold, as it is a Rest of the Parts of a Body kills Living Creatures.*

That *Cold* is the Cause of the *Death* of *Living Creatures*, must not seem strange to us, seeing that our *Bodily Life* consists in the various agitation of the *Blood*, *Spirits* and *Humours*, upon the diminution or cessation whereof, *Life* it self must cease also. For as by too intense *Cold*, that is, by the consistence of the insensible *Particles* of the *Air* and *Water*, the *Water* that turns a *Mill* is congealed; so the total cessation or diminution of the *motion* of the *Blood* and *Spirits* in the *Bodies* of *Living Creatures*, deprives them of *Life*. As we find, that in the *Winter* time, *Flies* and many other *Living Creatures* consume and *dye*, especially when the *cold* is very intense.

XV. *What Potential Heat and Cold is.*

As there is an *Actual Heat* and *Cold* found in *Bodies*, so some *Bodies* are said to be *Potentially hot* or *cold*. Those are called *Potentially hot* [illegible] *which have an aptitude or disposition to grow hot, or heat other things*; which ariseth from hence, that their *particles* are so disposed, that they are liable to be more violently moved by the *Subtil matter*,

matter, which runs through all *Bodies*. Thus *Quick-Lime*, which is *cold* to the Touch, is said to be *hot Potentially*, because the *Subtil matter* can easily excite an Agitation in its *Pores*. In like manner all other *Bodies*, which can produce such a *motion* in the *Particles* of other *Bodies*, are said to be *Potentially hot*; such as are *Pepper*, *Ginger*, *Spirit of Wine*, and the like. And on the contrary, that *Body* is said to be *Potentially cold*, whose *Particles* cannot be agitated by the *Subtil matter*; or whose disposition of *parts* is such, as to hinder the *particles* of any *Body* to be put in agitation by others; such as are *Lettice*, *Vinegar*, *&c.*

CHAP. XXIII.

Of the various Effects of Fire.

I. *Some Effects of Fire remain still to be explained.*

HAving hitherto consider'd the Nature of *Fire*, and how it diffuseth *Light* from it self through the *Air*, and communicates *heat* to those *Bodies* that are near it; it remains now that we explain some other of its *Effects*, *viz.* how it *rarefies* and *condenses* some *Bodies*, *softens* and *melts* others, and again *hardens* and *dries*; changeth some into *Calx* or *Ashes*, and others into *Glass*. In order to the giving of a Reason for these different *Effects*, we are to presuppose that *Rule* of the *Philosophers*; that, *Every Action is received, not so much according to the manner and condition of the Agent, as according to the Disposition of the Patient.* The *Action* of the *Fire* is every where one and the same; but the difference of the *Effect* proceeds from the diversity of the Matter whereon it acts.

II. *How the Fire rarefies Bodies.*

In the *First* place therefore, if a *Body*, whose Parts are pretty close together, be very much heated, let those *parts* be of what *figure* they please, provided only that they be not *Round*, whilst they are whirl'd about their own *Center*, they cannot but meet with their *Corners*, and push one another, and then such a *Body* is said to be rarefied; as appears in *Milk*, when it *boils*, as well as in other *Liquors*. The same may be often perceived in *hard Bodies*, which being heated, do lose few of their *Particles* by *Exhalation*. Thus *Red-hot Iron* is more *turgid* than that which is *cold*.

III. *How it condenseth them.*

But in case the *Parts* of a *Body* be very *light*, and very susceptible of Agitation, and yet have some slight Coherence; yet so, as that they scarcely touch one another, and constitute a Whole, that is, of a very *loose* and incompact *Substance*, the least *heat* supervening to such *Bodies* as these, and communicating some *motion* to their *parts*, disposeth them to a nearer *Conjunction*, and by this means condenseth the whole *Body*: As when *Heat* reduceth *Snow* to a less *bulk*, by making the *parts* of it closer together.

IV. *How Bodies grow soft by the force of the Fire.*

The *Fire* softens *Bodies*, by agitating their *Particles* with so moderate a *Motion*, as doth only move them, without separating them from one another. Which happens only in those *Bodies* that consist of such *parts*, as are with equal facility separated from each other; as in *Wax*, *a hot Hand*, *Lead*, and other such like, whose insensible *parts* are not wholly without *motion*, tho' the slowness of it make it imperceptible.

V. *How Bodies are melted by the Fire.*

The *Fire* melts *Bodies*, whilst it not only moves their *Particles*, but also separates them from each other, as to their *situation*. For by the violent agitation of the *Fire*, the *particles* of *Bodies* are separated from one another, and most swiftly moved. And accordingly *Metals*, tho' otherwise *hard Bodies*, are by the force of *Heat* melted, and resolved into *Homogeneal Particles*, as they are usually called.

VI. *How Bodies by Fire are resolved into Vapour, and afterward turn to Water, or other Liquor.*

A like Effect of *Fire* is *DISTILLATION*, by means whereof a *Body* is changed first into *Vapour*, and afterward, as that *Vapour* condenseth, is turn'd to *Liquor*: Which may be done several ways, according to the several *degrees* of *Fire*, as by the *moist Heat*, as the *Chymists* call it, which is that of a *Balneum*, or by the *dry heat* of *Ashes*, *Sand*, or a *naked Fire*. And by this separation of *parts*, there are distill'd from *Bodies* first *Burning Spirits*; then *Phlegm* or insipid *Water*; and lastly, a sharp and *corroding Liquor*, which by a very violent *Fire* is distill'd from *Salts*.

VII. *How Bodies come to heat and boil, by means of Fire.*

But if the *agitation* of the *Liquid particles* be so great, that some of them be carried *upwards*, or be changed into *Air* or *Fire*, and so requiring a greater Space wherein to dilate themselves, and to pursue their *motion*, do thrust other *Bodies* out of their places; then these *Liquid Bodies* become very *hot* and *boil*. Now this great *Heat* or effervescence is carried on with an equal *motion*, and without any great perturbation of their *parts*, when the said *Liquid Bodies* do not contain much *Heterogeneous matter*; as it happens in *Wine* and *pure Water*. But they *boil*, where the Matter of *Bodies* is more *Heterogeneous*, partly *spirituous* and *volatile*, and partly *thick* and *clammy*, or ropy: These being the two Matters that concur to the making of *Bubbles*; for *viscous* and *clammy Matter*, serves to make the *Skins* of the *Bubbles*, and the *volatile Matter* furnisheth that *Aiery Spirit* that fills and distends them. But if the *agitation* of the *Heat* be not strong enough to overcome the *Heaviness* of *Bodies*, then it cannot dilate those *Bodies*, so as to make them take up a greater Space. And therefore it is, that the *particles* of *Metals* do not fly up into the *Air*, because the force of Heaviness that is in them, surpasseth the Activity of the *Fire*.

VIII. *How it comes to pass, that the Fire harden and dries some Bodies.*

As the *Fire* softens and melts some *Bodies*, so it *hardens* and *dries* others, *viz.* such as are compounded partly of *thin*, *flexible*, *slippery* and *volatile Parts*; and partly of *Thick* and *Branchy parts* mix'd together, but not very firmly sticking to one another. For that *Body* is said to be *dry*, which *wants those fluid Particles*, *which when united together do constitute Water*, *or any other Liquor*. Such *Bodies* as these therefore, as soon as they come near the *fire*, their fluid and thin *Particles* being exhaled or turned into *Vapour*, become *dry*, and their thick and branchy *Particles* are left alone by themselves; which being more nearly and closely joyned, and with greater firmness hanging together, do constitute *hard Bodies*. As is manifest in *Clay*, some of the *pores* whereof are by *heat* shut up, and others again dilated and left more open.

IX. *How Fire turns Bodies into a Calx and Ashes.*

Another Effect of *Fire* is, that it separates most *Bodies* either into a kind of *Calx*, or into *Ashes*, according to the various application thereof. For when those *Bodies* that are apt to melt, are so

placed, as that a violent *flame* of *Reverberation* may beat upon them, they become turned into a *Calx*. For all *Hard Bodies*, which by the Action of *Fire*, are reduc'd to a *powder*, by expulsion of some of their thinner *Particles*, which joyned the other *parts* together, are said by the *Chymists* to be turned into a *Calx*. So that *Calcination* is an *Operation*, whereby a *mix'd Body*, especially *Stones* and *Metals*, are reduced into a small *Powder*. Neither is there any other difference between *Ashes* and a *Calx*, save that *Ashes* are the Remainders of those *Bodies*, whereof a great part hath already been consumed in the *fire*: Whereas a *Calx* is of those *Bodies*, which suffer little or no diminution at all by the Action of *fire*, as not being inflammable. And both of them agree in this, that they consist of solid and thick *Parts*, such as by the ordinary force of the *fire* cannot be changed into *Vapours*, and are of *irregular* and many *Corner'd figures*; so that they only lye upon one another, without sticking close together, and probably do not touch one another, but in some very small Points.

X. *How these Calces, and the Ashes of Bodies are by Fire turn'd into Glass.*

If afterwards these *Calces*, or the *Ashes*, are committed to a strong and long continued *Fire*, their *Corners* or *Angles*, which are the cause of the Roughness and Opacity that is in *Ashes*, become bended, by which means the *particles* being agitated and tost together, are at last more closely joyned, polished, and made more smooth, which touching each other only, according to little *Surfaces*, do constitute that *hard*, *transparent* and *brittle* Body, which is commonly called *Glass*.

XI. *Why Glass is hard, stiff, transparent, and brittle.*

GLASS is a *hard* and *stiff Body*, because it consists of thick and inflexible *particles*, which are not joyn'd together by any intangling of the *Branchy parts*, but by contact only. It is *Transparent*, because after its concretion or coagulation it still retains its *Pores*, through which the *Heavenly Globuli* can continue their *motion* to *Right Lines*, according as they were moved before, when it was *Liquid*. Lastly, It is *Brittle*, because the *Surfaces*, in which its *particles* touch one another are very small.

XII. *How Earthquakes are caused by Fire.*

Fire not only exerts its Activity upon the *Surface* of the *Earth*, but also in the *Cavities* or Inward parts of it; where it is the cause of EARTHQUAKES, as often as any great store of *Exhalations* are found there: Not that they of themselves are able to produce this effect, seeing their *Particles* do only constitute the *Air*; but because they easily mingle themselves with the more *Subtil particles* of *Spirits*, and being heated and kindled by them, seek for a larger *place* wherein they may dilate themselves; and being not able to find that, they shake all that stands in their way: Much in the same manner as *Gunpowder*, shut up in a Mine, as soon as it is kindled, by endeavouring to make room for it self, makes a great Concussion, making the *Earth* to *quake*. Which is the reason why those places are most subject to *Earthquakes*, which abound with Veins of *Saltpeter*, *Brimstone*, or other *Oleaginous matters*; these being easily kindled by *Spirits*, or by any *spark* of *Fire*, from the dashing together of *Stones* or *Flints*. And as soon as they are kindled, not being able to contain themselves in the same Space, they are carried upward, and break through their Prison Walls, to make room for themselves.

XIII. *Subterraneous Fires act differently.*

EXHALATIONS, kindled in the *Holes* of the *Earth*, do break forth outwardly on the *Surface* of it, when they are of force enough to make a way for themselves thro' the outward *Crust* of the *Earth*; but when they are not of strength enough to do this, they only cause a *simple Earthquake*, that is, they only make the *Country* round about to rise a little; as *Gun-powder* raiseth the *Terrasses* that lead to the Mines. *An Earthquake* therefore *is* nothing else, but *the Shaking of any Place or Country, which is accompanied sometimes with a breach of the Ground, and a terrible Noise.*

XIV. *What Fermentation is, and the Cause of it.*

FERMENTATION is accounted amongst the Effects of *Fire*; and happens, when the Matter of the *first Element* is so shut up in the narrow *Pores* of *Earthly Bodies*, that tho' many thick *Particles* swim in their little Spaces, yet are they so agitated by some *Watry* and *Airy particles* that are insensibly mix'd with them, as to be able to affect our *Nerves*, and produce the perception of *Heat*. Such a fervescence or rising is found in *Dough*, and in the working of *New Wine*, Beer, and other potulent *Liquors*: So likewise in *Oil of Vitriol*, mix'd with *Salt of Tartar*; *Aqua-fortis*, in which *Copper* is put, and other such like. Because the *Particles* of these *Bodies* are so agitated by the *Æthereal matter*, that runs through their *Pores*, as not only thereby to be heated, but also rarefied and subtiliz'd; so that the Hooks and Intanglements, whereby their *Particles* before were held and kept together, are dissolved. *Fermentation* therefore *is* nothing else, but *the adventitious and expansive Motion of the insensible Heterogeneous parts of fermenting Bodies, excited without any sensible Cause.*

XV. *Heterogeneous Particles are required to the Motion of Fermentation.*

Bodies subject to *Fermentation* are not of one kind; for they may be either *Animate*, or without *Life*, *Thin* or *Thick*, *Natural* or *Artificial*, provided they do consist of *Heterogeneous parts*. Now this *Heterogeneity* of *parts* is found in those *Bodies*, which are compounded of *Particles*, whereof some are in continual *motion*, and others again are *Earthly*, *thick*, and more *fix'd*, which hinder the more *Volatile parts* from flying away. For on this contrariety and *strife* of the Parts *fermentation* chiefly depends; for where the *Particles* are of the same *figure* and *conformation*, no *fermentation* can be excited. Thus we find, that *New Beer*, or *Wine*, when shut up in narrow Mouth'd *Bottles* do ferment or work with such Violence, that they often break the *Bottles*: Whereas if the *parts* of these *Liquors* be separated by *distillation*, they will no longer be capable of *fermentation*. For which Reason, *Stillatitious Oils*, *burning Spirits*, and *distill'd Waters*, will continue a vast while without the least change by *fermentation*. Thus *Spirit of Wine*, shut up in a *Bottle*, is very far from falling into a fret or effervescence; but if you add some *Oil of Turpentine* to it, it excites such a commotion of the *parts*, as endangers the breaking of the *Bottle*, in case it be close stopt.

CHAP.

CHAP. XXIV.

Of the Mixtion of Bodies: As likewise of their Changes, Converſion, Generation, Corruption, Alteration, Augmentation and Diminution.

I. *There is a twofold Mixtion of Bodies.*

THAT it may be the better apprehended what *Mixtion* is, we are to obſerve that things may be mingled after a twofold manner; the *firſt* way is, by a *Compoſition* or rather *Appoſition* of the things to be mingled. The *ſecond* by their *Coalition* or *Confuſion*.

II. *What Appoſition and Confuſion is.*

Thoſe *Bodies* are ſaid to be mingled by *Appoſition*, whoſe parts do not wholly mix and run through one another, but only *ſuperficially* touch one another, keeping their diſtinct natures, as when *Fruits* of ſeveral ſorts are heaped together, and make one heap. But the *Mixtion* by *Coalition* or *Confuſion* of *Bodies* is, when they are ſo mingled, as that they wholly run through one another, ſo that there is not the leaſt *particle* aſſignable in the *mixt Bodies*, which doth not conſiſt of every one of them. According as ſome think that the parts of *Water* pour'd into *Wine*, are ſo throughly mixed with the parts thereof, as to be ſuſceptive of the ſame *Action* and *Paſſion*. This laſt kind of *Mixtion ARISTOTLE* ſeems to defend *lib.* 1. *de Generat. cap.* 10. where he aſſerts that a new *ſubſtantial form* is produced in *Generation*, and that there is no part of the *mixt Body* ſo ſmall but is mixed.

III. *Ariſtotle's miſtake about the Mixtion of Bodies.*

But this opinion of *Ariſtotle* is not at all probable, for if we ſhould ſuppoſe the moſt perfect *mixtion* of all the moſt minute parts of a *Body*, this would deſtroy the very nature and notion of *mixture*; ſince it is the common notion of *mixture*, that the *things* mixed muſt ſtill continue; for if they do not abide, then it is not a *mixture* of ſeveral things, but a deſtruction. Beſides, if the *parts* of a *Mixt Body*, do wholly through and through pierce one another, ſo as to be coextended every way, then two *Bodies* will be in the ſame place, ſeeing there is no part ſo ſmall that is not mixed, and that is not partaker of all the parts both in *ſubſtance* and *quality*. From hence alſo it will follow, that a ſmall *Body*, by example a *Pint of Water*, will be equal and coextended to a far greater *Body*, *viz.* a *Gallon of Wine*, ſeeing that there is no part ſo ſmall, which does not conſiſt of *Wine* and *Water*.

IV. *The opinion of the Peripateticks concerning Mixture.*

Some *Ariſtoteleans*, to avoid theſe abſurdities, tell us, that all *Miſcibles* are not of the ſame *Power* and *Virtue*, and that the weaker do yeild to the ſtronger. So that when *a drop of Water* is caſt into a *Hogſhead* of *Wine*, it produceth no *mixture*, but that the form of the weaker part, *viz. Water*, is by the more powerful *Wine*, changed into its own nature, ſo that by the addition of this drop of *Water*, the *Wine* contained in the *Hogſhead* is encreaſed one drop.

V. *The Peripateticks confuted.*

But this Evaſion doth not agree with Reaſon; for I will only demand of them, whether this *drop* of *Water* caſt into the *Hogſhead* be changed into *Wine*? They will ſay it is. But if after this firſt drop, another and another be put in, and this continued, till the firſt quantity be 2 fold, 10 fold, 100 fold, 1000 fold encreaſed, what will be the kind or ſubſtance of this *Liquor* then? The *Peripateticks* according to their *Principles*, muſt ſay that the whole Maſs of this *Liquor* will be pure *Wine*, tho' inſtead of one *Gallon* of *Wine*, a 1000 of *Water* may have been pour'd into it drop by drop, ſince according to them, every drop of *Water*, by the overpowering quantity of *Wine*, was turned into *Wine*. But is not this abſurd? If they will not own this, let them tell us when the *VVine* began to loſe its form; and at what particular *drop* of *VVater*, the whole maſs of *VVater* became deprived of its form. But here they muſt be ſilent, and tho' ſore againſt their wills, acknowledge their Ignorance.

VI. *That Mixture is cauſed by Appoſition.*

Wherefore rejecting this *Sentence*, we muſt adhere to the former, and maintain that the *Mixtion* of *Bodies* is performed by the appoſition of *particles* to each other: Thus when *VVine* and *VVater* are mixed together, the parts of each *Liquor* continue in their diſtinct natures; ſo as that the *particles* of *VVine* and *VVater* are not in the ſame, but in diſtinct places, as black and white *Threads*, in the Weaving of any *Stuff* or *Cloath* do each poſſeſs their diſtinct intervals. Neither muſt it ſeem contradictory to what we here aſſert, that the mixture of *VVine* and *VVater*, cannot be perceived by our *Senſes*, becauſe the *particles* of *VVine* and *VVater* are ſo ſmall and ſubtil that they cannot be perceived by our *Sight*, nor diſtinguiſht by our *Taſt*.

VII. *Experiments proving Mixtion to be by Appoſition.*

And certainly we have great reaſon to believe that *Mixtion* is performed after this manner, ſince we find that *Bodies* that are *mixed* may be ſeparated again from each other. Thus *VVine* that is mixed with *VVater* may be ſeparated from it, either by a *Spunge* dipt in *Oyl*, or by a *Cup* made of *Ivy*, or by extream *Cold*, which *freezing* the *VVater*, leaves the *VVine*, or at leaſt the moſt *Spirituous Part* thereof in the center of the *Icy maſs unfrozen*. And the ſame is almoſt perceived in every *Body*, wherein there is but a little quantity of *Sulphur* and *Spirit*; for if you *diſtil* out of *Vitriol*, *Tartar*, *Saltpeter* and the like, their *Phlegm* and *Acid Spirit*, and after *diſtillation*, put them again to the remaining dregs, which the *Chymiſts* call their *Caput Mort*, you will find the ſame *Body* reſtored, which was before *diſtillation*, and almoſt of the ſame quantity or bigneſs as it was before. *Chymiſts* obſerve that when they mix the *Spirit of Vitriol* with the *Salt of Tartar*, there at firſt happens a great effervеſcence or ebullition, and when that is over, both the *Liquor* and *Salt* do quite loſe their ſharpneſs and acrimony, ſo that the *Body* remaining after this their effervеſcence, is a meer inſipid *Body*: But if then by *diſtillation* you ſeparate the *Spirit of Vitriol* from the *Salt of Tartar*, you'l find that neither of them are deprived of their former *virtue* and *force*, but that they are as ſharp and corroſive as before. All which *Experiments* do give us an undoubted evidence, that things after *mixture* retain the ſame nature they had before, and that *Mixture* is performed by *Appoſition* of the *Particles* of one *Body* to thoſe of another.

VIII. *What Mixture is, and how many ſeveral ways the ſame may be.*

Mixtion therefore or *Mixture is* nothing elſe but *the Collection of divers Bodies into one, and that by way of Appoſition.* It may be performed divers ways. 1*ſt*. By *Percolation* or ſtraining; thus *Blood*, *Urin*, *Medicinal VVaters*, *Stones*, almoſt all *Juices*, *VVine*, *Oyl*, &c. are made. 2*ly*.

2*ly*. By *Coction* or by Baking, thus *Salt*, *Bricks*, *Earthen ware* and *Glass* become one mixt *Body*. 3*ly*. By *Sublimation*, thus *Soot*, *Snot* or *Snivel*, and, it may be *Metals* also, and some *Salts* used by Chymists are made. 4*ly*. By *Distillation*, as many sorts of *Water*, *Rain*, *Dew*, *Manna*, and other things are made. 5*ly*. By *Dissolution*, thus *Salt-water*, the *Chyle*, or *nutritive Juice*, and dissolved or *melted Bodies* are made. 6*ly*. By *Exhalation*, as *Flame*, *Steams*, *Clouds* and other such like. 7*ly*. By *Concretion* or growing together, as *Snow*, *Frost*, *Hail*, the *Stone* in *Mans Body*, &c. 8*ly*. By *Calcination*, as many sorts of *Salts*, *Ashes*, *Quick-lime*. 9*ly*. By *Simple Commixtion*, as *Wine* mingled with *Water*, *Ointments*. 10*ly*. By *Simple Expression*, as *Wine*, *Oyl*, and most other *Juices*.

IX. *The Changes of Natural things.*

Mutation or Change *is the Vicissitude or Alteration of any thing, but chiefly of such as are bodily.* The nature whereof we shall the better apprehend, by taking notice that all Changes are of two kinds, *viz. Accidentary* or *Essential*. An *Accidentary Change* is that whereby only some *Accidents* are changed, which do not constitute the essence of a thing, such as are the changes of *Heating* and *Cooling*. *Essential Changes* are those wherein the *essences* of things are changed by the *Introduction* of a *New Form*, and by depriving them of the Form they had before. And forasmuch as according to what hath been said in our *General Physicks*, there are in the usual sense of the *Peripateticks* no substantial Forms, besides the *Soul* of *Man*, it follows that neither can there be in their meaning any *substantial change*, save that in the *production* of *man*, because in no other *production*, any such new *substance*, as they understand, is made; but in all Alterations and *Generations* the *matter* or common *subject* is only Accidentally or Essentially modified according to *Measure* or *Quantity*, *Rest*, *Motion*, *Position* and *Figure*.

X. *What Conversion is.*

To be more particular, *Conversion is that Action, whereby one thing is changed into another, by the Alteration of its former Modification, and the introduction of another, diverse from the former, the same common subject still remaining.* It is said that the *same Common Subject remains*: For the *Matter* which is the *Subject*, is numerically the *same* after the *Change*, as it was before, being only *Modified* anew. And this is well to be observed, because that otherwise it will not be any true *Conversion* or *Change* of one thing into another, but rather an *Exchange* of one thing for another.

XI. *The difference between an Accidental, Essential and Substantial Conversion.*

That *Action*, which is terminated in those *Modes* or *Accidents* that may be present or absent without the destruction of the *Subject*, is called an *Accidental Conversion*. But that which is terminated in that peculiar Modification, which is *Essential* to any thing, and doth distinguish it from all others, the same is called an *Essential Conversion*, and sometimes *Substantial*, inasmuch as it affects the very *substance* or *subject* it self, so and so modified. For indeed by the *substance* of any thing we are not to understand that *bare Entity*, which is conceived to be the *Subject* of the *Form*, and to be specificated by it, but both *Subject* and *Form* taken together, to wit, that *Thing* which consists of them both, or rather the *Subject*, as I said, it self, as considered with its peculiar *Modification*: So that when this *Constitution* or *Modification* is changed, and another introduced into the common *Subject*, it is evident that then the former *substance* is also changed, and turned into another. Thus when that peculiar *modification*, which constitutes the nature of *Wood*, is changed, and the *Essential* disposition that constitutes a *Stone* is introduced, in this case we must say that the *Wood* is *essentially* and *substantially* changed into a *Stone*. And so likewise in the case of *Nutrition*, when *Corn* is reduced to *Flower*, that to *Bread*, and the *Bread* into the *Blood* and *Flesh* of our *Bodies*, this I say is an *Essential* and *Substantial Conversion*.

XII. *What Generation is.*

So likewise *Generation* is nothing else but a certain disposition of matter according to the foresaid *Modifications* of *Measure*, &c. as in the Production of *PLANTS* and *BEASTS*; because in the *generation* of either of these, a new *substance* is no more produced, than in the framing of a *Statue*, or the building of a *House*. Now what happens to *Stone* or *Wood* when it is framed into a *Statue*, more than a new form or habitude in the matter of *Wood* or *Stone*? So likewise in the building of a *House*, there is no other change but what ariseth from the joining of *Stones*, *Boards*, *Tiles*, *Nails*, &c. which before were separate, but now being set together make such a composure or *structure* as hath the form of a *House*. And tho' the framing of a *Statue*, and the building of a *House* do terminate in a *Substance*, for both the *Statue* and *House* are *Substances*, yet no new *Substance* other than I have before asserted, is found in either of them, there being nothing superadded to them besides a new *Modification*, with which both these *Substances* are affected. Accordingly, *Generation is* nothing else but *a translation or new ranging of the parts of matter*, which is alike in Natural and Artificial *Compositions*.

XIII. *What Corruption is.*

As for *Corruption*, *it is* nothing else but *the dissolution of parts that were before united*. Thus as a *House* is said to be destroyed when its several parts are separated from each other; so *Wood* or other combustible *matter* is said to be corrupted or destroyed, when by *Flame* it is resolved into *Ashes* and *Smoak*. The Cause of the *Corruption* of *Bodies* is when strange *particles*, by thrusting themselves into their *pores*, do thereby change and destroy the Texture, Connexion and order of their *Parts*. Hence it is that those *Bodies* that have less *pores*, are for the most part more durable than others, and less subject to *Corruption* or *Destruction*.

XIV. *What Alteration is.*

Alteration is nothing else but the *change*, whereby a *subject*, still abiding the same, becomes changed as to some *Accidents*. So *Water* is said to be altered, when it is *heated* by the *Sun* or *Fire*: and a *Man* is said to be altered, when of *Healthful*, he becomes *Sick*, and of *Ignorant*, *Learned*, &c. Because *Man*, by supervening *Sickness* or *Learning* is not changed into another thing than he was before. And therefore *Aristotle* in the 1*st*. *Book of Generation chap.* 4. defines *Alteration to be that whereby a sensible subject, abiding still the same, becomes changed in its affections*.

XV. *What Augmentation or Growth is.*

Augmentation or *Growth*, to speak properly, is nothing else, but *Nutrition*, whereby more *substance* is restored, than was lost or dissipated. For *Augmentation* is never performed without *local Motion*, since nothing can grow or encrease, but by the

the acceſs or appoſition of *aliment* to its parts, and by the union thereof with them. Thus when the *Innate Heat*, and *Temperament* of the *Body* are ſuch, as that more prepared *Food* or *Aliment* is added to it, than it has loſt, that *Body* is ſaid to grow or encreaſe. As when a *Tree* by the *Juice* it draws out of the *Earth* grows taller, and ſpreads wider.

XVI. *What Diminution is.*

The *Diminution* or *Decreaſe* of *Bodies*, is when this *Nutrition* ceaſeth, and when leſs *Subſtance* is reſtored than has been diſſipated or loſt. The *Cauſe* of *Diminution* is, either the want of *Food*, or when the *Food* is not ſuch as is proper to feed the *Body*; or becauſe of the weakneſs of the *Innate Heat*, as happens in thoſe that are *Old*; or becauſe the ſaid *Heat* is too ſtrong, as in thoſe who are of a *Cholerick Temperament*; or when the *Body* is ſo diſpoſed, that it cannot be ſupplied with ſufficient *Food*: Or laſtly, when the little *conſtitutive parts* of the *Body* begin to waſte and are conſumed, whatſoever may be the cauſe of it; for then the *Muſculous Parts* fall down, and grow *Flaggy* for want of a ſufficient acceſſion of new *Subſtance*, cauſed by a too ſparing ſupply of *Food*, or becauſe the ſame is not fitly prepared or concocted. Whence we underſtand that *Augmentation* or *Growth*, and *Diminution* do conſiſt in *Local Motion*.

The Seventh Part
OF THE
INSTITUTION
OF
PHILOSOPHY.
OF
LIVING CREATURES
In General: And Specially of
PLANTS and ANIMALS.

The INTRODUCTION.
Of the Diviſion of Living Creatures.

I. *The Diviſion of Bodies into ſuch as are living and deſtitute of Life.*

HItherto we have conſidered the Nature of *Inanimate Bodies*, whether hid in the *Bowels* of the *Earth*, or expoſed in the Face of the *Heavens*. And now we proceed to *Living Bodies*, viz. *Plants* and *Animals*, which are comprehended under this *General Notion*, becauſe they are endued with *Life*, and are furniſht with *Inſtruments* appropriated to *Nutrition*, *Growth* and *Propagation*. For all Bodies in the Univerſe are either *Living* or *devoid of Life*. Amongſt thoſe that are without *Life* are reckoned *the Heaven*, *the Stars*, *Fire*, *Air*, *Water*, *Earth*, *Metals*, *Stones* and *Foſſils* or things dug out of the *Earth*: So that of all the *Creatures* contained in the World, *Plants* and *Animals* only are endued with *Life*.

II. *What Living Bodies are.*

Now we call thoſe *Living Bodies*, *that have received from the Author of Nature ſuch a Diſpoſition of an Organical Body, as that by innumerable paſſages and conveyances it hath, the Alimentary juice, being by motion thruſt into them, is by the Soul every way diſperſed and diſtributed, for their Nouriſhment, Growth and Conſervation.* They are called *Living* Bodies from the *Life* they poſſeſs, and *Animate* Bodies from their *Soul*.

III. *What the Vegetative Soul is.*

This *Soul*, a fit Diſpoſition of *Parts* being firſt ſuppoſed, chiefly conſiſts in the *Innate* or *Inborn-heat*, which is a *Heating*, but not a *Shining Fire*, *generated* in *Bodies* at their firſt *Production*, by means whereof the *Alimentary Juice*, for their *conſervation*, is duly prepared, and diſtributed throughout the whole *Body*, and joined to the ſeveral parts of it, for a ſupply of that which daily waſtes away, by which means *Vegetation*, that is, *Nouriſhment* or *Nutrition*, and Encreaſe or Growth are performed. And therefore this *Soul* is called *Vegetative*.

IV. *Why a Body is ſaid to live and die.*

The *Life* flows from this *Soul*. For if the *Heat* be preſerved and maintained by convenient *Moiſture*, as its proper *Food*, then that *Body* is ſaid to *Live*; and on the contrary to *Die* or *Periſh*, when *Cold* and *Drineſs* do ſo predominate in it, as that the *Inborn Heat* becomes thereby diminiſhed or quite taken away.

V. *There are two General Heads of Living Bodies, Plants and Animals.*

Now foraſmuch as *PLANTS* and *ANIMALS* do both of them enjoy the common degree of *Life*, and reſort under *Vegetable* as under their Immediate *Genus* or *General Head*, we muſt firſt conſider their *Affections*, and whatſoever doth in general belong to them; as for Example, *wherein chiefly the Nature of Living Bodies doth conſiſt; how ſuch as are Vegetable differ from thoſe that are devoid of Vegetation; what that Heat is whereby they are Cheriſhed and Live, and whence their difference is deriv'd.* For there are two *General Heads* of *Living Bodies*; the *Firſt* whereof are thoſe, which according to their outward and inward *ſhape* exhibit a *ſubſtance* equally extended; and wherein from the top to the bottom we perceive but one and the ſame progreſs of *Nature*; ſo that all their *parts* are nouriſhed, grow and are generated, without any diſtinction in their *operations*; their *Bodies* being as ſo many *Channels* and *Pipes* through which the *Food* is tranſmitted, and in which it undergoes ſeveral changes. And theſe are called *PLANTS*, which draw up an *Alimentary Juice* out of the *Earth* by their *Roots* into the *Stem* or *Stalk*, which from thence is conveighed and ſublim'd to all the utmoſt parts.

VI. *The Definition of a Plant.*

A *PLANT* therefore *is a Living Body furniſht with a Skin, Strings, Root, Stalk or Stem, and other Organical Parts, and is nouriſht, grows and produceth its like from prolifick Seed, only by means of a Vegetative Soul.* So that all theſe *Plants* which ſpring out of the *Earth*, or grow in ſtanding *Pools* or *Water*, or elſewhere, provided they grow and are nouriſhed, whether they have *Roots* or not, whether they have *Leaves* or not, whether they have *Flowers* and *Fruit*, or have only a *Root*, all theſe, I ſay, are called *Plants*.

VII. *Plants are divided into Trees and Herbs.*

But foraſmuch as the name of *Plant* doth not only belong to thoſe *Bodies* which grow out of the *ground* by their *Roots*; but alſo to all thoſe that grow upon other *Plants*, or that ſpring out of the ground ſome other way; therefore *Plants* by a general diviſion may be diſtinguiſhed into *TREES* and *HERBS*, as the two members that comprehend all *Plants*. A *Tree* is a *Plant* riſing out of the *ground* with a *woody Stem* or *Stalk*, and growing up to conſiderable Height. An *Herb* is a *Plant* conſiſting of *Leaves* and a tender *Stalk*, never riſing to the tallneſs or thickneſs of *Trees*. Some *Authors*, beſides theſe 2 members, place a *SHRUB* as a third thing between a *Tree* and an *Herb*, but, as it ſeems, without any neceſſity, foraſmuch as there be no *Plants* but may be conveniently reduced either to *Trees* or *Herbs*; a *Shrub* being nothing elſe, but a *Tree*, which riſing out of the *Earth*, variouſly ſpreads it ſelf into *Branches* and *Leaves* from the *Root*. For a *Shrub* riſeth higher from the ground than an *Herb* doth. As to *Muſhrooms*, &c. they may be reckon'd amongſt thoſe *Plants*, that grow upon other *Plants* or ſpring forth at their *Roots*. To which alſo may be referred ſome *Plants*, which do not ſpring out of the *Earth*, but from other *Plants*, ſuch as are thoſe ſmall Strings that grow upon *Pulſe*, and being intangled with them are carried upwards into the *Air*. As for *Moſs* it may be well called an Excrementitious *Plant*, becauſe from its original *Seed* it grows upon barren *Ground*, and *Stones* it ſelf, in which its ſpreads its *Roots*.

VIII. *The Diviſion of Trees into Wild and Domeſtick.*

Trees are commonly divided into *Wild* and *Domeſtick*, or ſuch as are *cultivated* at home, and thoſe that are *Outlandiſh*: Not but that all *Trees* as to their firſt original may be called *Wild*, as having grown firſt wild in the *Fields*: but becauſe there are many *Trees*, which men do not take the pains to *Tranſplant* and *Cultivate* in their *Gardens*, and if they ſhould, yet would not they thereby change their wild *Nature*, whereas others being *Tranſplanted* and *Cultivated* by the induſtry of *men*, are much improved thereby.

IX. *The Second General Head of Living Creatures are thoſe we call Animals.*

The Second General Head of *Living Bodies* are ſuch as conſiſt of a far greater variety and multiplicity of *Parts*, have peculiar *motions*, and ſeem to conſtitute many *whole Bodies*, which yet are joined together with that proportion, as to produce proper and neceſſary *motions*; ſo that from theſe different *Parts*, certain *Machines* or *Engines* do ariſe, moſt curiouſly wrought and contrived, which are called *Animals*, whoſe members are not only complete in themſelves, but are alſo joined with that exact *Symmetry* and *Proportion*, as to conſpire to the Good and Profit of the *Whole*, and concur to one *motion*. And notwithſtanding that in the *Prædicamental Line*, and the *Genealogy* of *Things* and *Modes*, an *Animal* is, according to the common way of *Philiſophizing*, conſtituted by ſomething *Senſitive*, which is true too, in a certain meaning; yet we are to take heed that we do not by theſe means *attribute* to an *Animal* ſuch a *Soul* and *Senſe*, as has *Perception*; ſince the *Senſe* of an *Animal* purely and alone conſiſts in the impreſſion of the *Object* on the *Bodily Organ*, which may be done without the Help of a *Soul*.

X. *The various kinds Animals.*

Animals are divided into ſuch as *flie* in the *Air*, *ſwim* in the *Water*, *go* on the *Earth*, *creep*, *ſlide along*, or ſuch as are altogether *immoveable*. They may likewiſe be diſtinguiſht from the difference of their *Generation*, *Parts*, *Actions* and other ſuch like. And accordingly ſome are *Viviparous*, ſuch as bring forth *Living Creatures*; others *Oviparous*, which lay *Eggs*, out of which *Animals* afterwards are hatched. As to Parts, ſome have *Wings*, others *Fins*, ſome go on two *Feet*, others on *four* or more. And others again want all theſe. As to their *Actions* or *Manners*, ſome are *Tame*, others *Wild*; ſome *Domeſtick* and *Sociable*, others delighting in *Solitude*; ſome *Stupid* and *Dull*, others *Quick* and *Cunning*. As to the *places* where they are *bred* and *live*, ſome are *Fiery*, others *Aquatick* or *Watry*, and others *Terreſtrial*. Some live both on the *Earth* and in the *Water*, which are therefore called *Amphibious*; ſome are *Subterraneous*, or living under *Ground*, &c.

XI. *The Sum and Order of things to be treated of in this Seventh Part.*

The moſt Noble and Excellent of all *Living Creatures* is *MAN*, for the handling of whom we deſign the *Eighth* Part of our *Inſtitution*, as being the Complement of all *Animals*, and to expreſs my ſelf, as ſome of the *Ancients* have done, *the Horizon of Heavenly and Sublunary Creatures.* Now foraſmuch as theſe *Living Things* do agree in ſome *affections*, we will here firſt touch upon thoſe, which are *common* unto them all; and then in *ſpecial* apply our ſelves to the Contemplation of *Plants* and *Animals*, and ſhall at large ſet forth the *diſtinction* that is between them.

CHAP.

CHAP. I.

How Living Bodies differ from those that are Inanimate, and destitute of Life.

I. *The word* Life *is taken in a threefold signification.*

IT appears from what hath been already said, that *Living Bodies* differ from *Lifeless things* in this, that the one have *Life*, and the other are devoid of it. But forasmuch as the word LIFE is *Æquivocal*, and attributed to things that are said to *Live* under different Notions; we must first consider what *Life* is, and how many significations it admits of. For the *Notion* of *Life* is very various and vagrant, but reducible to 3 General Heads. Sometimes we make use of this word to signifie *Simple Existence*; sometimes, *Active Existence*; and sometimes also, *Coexistence*, or the *Duration of one thing with another*.

II. *What a Life of Simple Existence is.*

That is a *Life of Simple Existence*, when the word *to Live* is taken simply for *Existence*: As when *BOETHIUS* defines *Eternity*, an *All at once* and *perfect Possession* of an *Interminable Life*. And in the same meaning *ARISTOTLE* calls the *Life* of *Animals*, their *Being*; because when they *die*, and cease to *live*, he thought they ceased to be also.

III. *What an Active, or Actuous Life is.*

An *Actuous Life*, is *a Life of Existence*, *accompanied with Action*; and in this Sense *Life* is taken for *Action* and *Operation*. Thus *Fire*, or a *Candle*, whilst it sends forth a *flame* is said to *live*; and so the *Vital Spirits* are said, to *live* in a *Body*, as long as they are in continual *motion*, and flow through the *Veins* and other hidden *Channels*. Thus we call *Spring-water*, *Living*, because it bubbles up, and flows continually; but *Dead*, when it stands still, and is without *motion*. In like manner, *Love* is said to be *alive*, whilst it is strong and active. So *Virgil*, in 1*st Æneid*:

——— *with Lively Love*
Strives to fore-stall.

IV. *What the Life of Existence with another is.*

The Life of Existence with another is, when *Life* is taken for the Duration of one thing with another; or for the *Duration* of some *Substance*, in conjunction with some *Accident*, whereby it is perfected. Thus the *Life* of *Man* is commonly said, to consist in the *Conjunction* of *Soul* and *Body*, and his *Death* in their *Separation*: As when CATULLUS saith, *Let's Live my* Lesbia: Where, by the word *Live*, he understands *Existence* in conjunction with *Joy* and *Pleasure*. So that *Life* taken in this Sense, consists in the union of two *Substances*; or in the union of a *Substance* with some *Accident*, from which it borrows some kind of Perfection.

V. *Of the difference that is between Living and Lifeless things.*

Living things are chiefly distinguish'd from *Lifeless things*, by the *Life of actuous Existence*, or because they are endowed with a certain Efficacy and Activity: For their *Life* properly consists in *motion*, which the Purest part of the *Blood*, if they be *Animals*, or of the *Alimentary Juice*, if they be *Plants*, communicates to the grosser parts of their *Bodies*: So that we find that *Plants* and *Animals* do soon perish, when the *Blood* by its *Circulation* ceaseth to quicken the *Members*, and when the *Juice* does no more enter through the *Pores*. For as *Bodily Life* consists in *Motion*, so *Death* consists in *Rest* or ceasing from *Action*. But for all this, we must not suppose, that there are any *Immaterial Souls* in *Living Bodies*, that perform these *motions*, and the Functions of *Feeding* and *Growth*; it being sufficient that their Parts be so disposed, as that the prepared *Alimentary Juice* may freely enter into their *Inward parts*, and by its apposition, restore and supply their dissipated *Substance*. Now all this may be done by *Motion* alone, provided only that the *Parts* be rightly disposed, and that there be an equal *distribution* of the *Juice* by means of *Heat*. I say therefore, that *Living Bodies* differ from *Lifeless things*, in that the former, by reason of the want of *Organs*, cannot admit such a distribution of *Aliment*, for the Restoration and supply of what is lost.

VI. *By what force or virtue the Alimentary Juice is distributed through the Pores of Living things.*

If so be any one demands, by what Force or Activity this *Juice* is diffused through the *pores* and *passages* of the *Body*, to all its *parts*, so as that they grow not only in *length*, but also in *breadth* and *depth*?

I Answer, That this is done by means of *Heat*, proceeding either from the *Sun*, or from *Fire*. For such is the Efficacy of the *Heavenly matter*, that is, of the *first* and *second Element*, that by passing through the thicker *Particles* of the *third Element*, it doth agitate them, and in so doing doth produce or excite *heat* in them; by which means these *particles* being rarefied, are carried upwards through the *Pores* of the *Roots*, to the *Stalk* or *Trunk*, and all other *parts*. Besides, there is in all *Living Bodies* a certain *Inborn* or *Native heat*, or rather a *fire* that is *hot* only, without *Light*; by the assistance whereof the *Alimentary Juice* is distributed through the whole *Body*, and joyning it self to it, doth preserve, enlarge and perfect it.

VII. *Lifeless Bodies are not subject to any certain figure, as Living Bodies are.*

Living Bodies also differ from such as are *Lifeless* or *Inanimate*; because these latter are not determin'd to any certain *figure*. Thus *Stones* may subsist under any *figure*: Some are 6 Corner'd, as *CRYSTAL*; some have a *crooked Surface*, as *FLINTS*; some have a plain *surface*, like a Plate, as *TALCK*; some have the *figure* of a *Lozenge* or *Quarry* of *Glass*. So likewise *Metals*, and all other *things* dug out of the *Ground*, do not require any *One precise figure*. But *Plants* and *Animals* cannot admit this variety of *figures*, as requiring a certain and determinate Conformation. For a *Plant* cannot be of any *figure*, but must have such a one, as is necessary for the drawing, concocting, digesting, and distributing of its *Aliment*. And 'tis for this Reason, that *Living things* only are furnish'd with *Organical Bodies*, which consist of such *Instruments*, as are proper to perform the several Functions of *Life*; such as are the *Root*, the *Stem* or *Stalk*, the *Branches*, the *young Shoots* in *Plants*; and the *Feet*, *Belly*, *Head*, *Bones*, *&c.* in *Animals*. Wherefore also a greater Beauty is found in the *Bodies* of *Living things*, than in *Artificial*; for since *Beauty* consists in Variety, it is evident that in *Living Bodies* there is a much greater diversity of *Parts*, than in others, whose *parts* are not so numerous, nor so fine and curious, nor so exactly and neatly joyn'd together.

VIII. *Artificial Bodies are not capable of Growth and Nourishment.*

Altho' in an *Artificial Engin*, or *Machin*, as likewise in a *dead Carkass*, or a *wither'd Plant*, there be many such like *Organs*, as are found in *Living Bodies*; according to what *Historians* relate of that *Wooden Eagle*, made by REGIOMON-

MONTANUS, which did fly in the *Air*, and ſhewed the way to the *Emperour*, as he was going to *Nurenberg*; and of the *Wooden Venus*, made by DÆDALUS, which could *walk* by the Artificial putting of *Quickſilver* into the Inward parts of it: Yet for all this, *Living* Bodies are very diſtinguiſhable from ſuch *Artificial* or *Dead* Bodies; becauſe they are nouriſhed and grow, by the *Alimentary Juice* admitted into their *Pores*; whereas *Artificial* and *Dead things* are neither capable of *Growth* nor *Nouriſhment*.

IX. *Living Bodies are productive of their like.* Laſtly, Herein alſo are *Plants* and *Animals* differenced from *Metals*, and other *Dead* Bodies, in that they can produce their like, and preſerve their *kind* by a ſucceſſive propagation of *Individuals*; which things dug out of the *Earth* are not capable of, as being deſtitute of *Seed*, or any Virtue whereby to *generate* an Off-ſpring.

CHAP. II.

The Life of Bodily things conſiſts in Moiſture and Heat.

I. *Living Bodies ſtand in need of Heat and Moiſture.* FOraſmuch as ſuch is the Conſtitution of *Living Bodies*, that they conſiſt of ſeveral *fibres* or ſmall *threds*, between which lye many large Conduits or Paſſages, through which the *Alimentary Juice* is ſtrained, and diffuſed into all parts; it cannot be queſtion'd, but the *Life* of *Plants* and *Animals* is ſupported by 2 things, *viz. Heat* and *Moiſture*, which mutually ſtand in need of, and aſſiſt each other. For *Moiſture* is the *food* of the *Heat*: And accordingly *Phyſicians* tell us, that *Life* conſiſts in *Moiſture*, as its *Paſſive*; and in *Heat*, as its *Active Quality*; and that all *Vegetative* Bodies do ſubſiſt and are preſerved by the ſame.

II. *The Fire that is in Living Bodies, is Hot only.* But to remove all Difficulty that might ariſe from the word *Heat*; we are to take notice, that we do not ſpeak here of a perfect *Fire*, which is both *hot* and *bright*, but of that which is *hot* only; ſuch as is found in *Horſe-dung*, and putrifying *Hay*: Which is therefore diſtinguiſh'd from the *Cæleſtial fire* in the *Sun*, and from the *Elementary*, which burns upon our *Hearths*; becauſe it doth not conſiſt as thoſe *fires* do, of *Particles* that ſwim in the *firſt Element*, and are toſt with a vehement *Motion* within themſelves; but proceeds from a kind of *fermentation*, cauſed by a mixture of *Heterogeneous* little *Bodies*. Tho' indeed, if we well mind its Operations, we ſhall find it to differ from the 2 former *fires*, *Solar* and *Culinary*, rather in degrees, than in nature and eſſence.

III. *There is a twofold Temperament in Living Bodies. The one according to Juſtice.* But foraſmuch as *Fire* is very *Active*, and cannot long be preſerved without *food*, we find that *Moiſture* is of abſolute neceſſity required for its preſervation and ſupport. From hence ariſeth the Temperament of *Living Bodies*, when *Heat* and *Cold*, *Moiſture* and *Drought*, are ſo temper'd and proportioned, that none of theſe *Qualities* hinder each other, but with an agreeing Diſcord harmonize together. And this kind of *Temperament* is by *Phyſicians* called, a *Temperament* according to *Juſtice*, when theſe *Qualities* are ſo mixed, that the *Heat* in *Living Bodies* is qualified by *Cold*, and the *Moiſture* by *Drought*, according to the requirings of each particular *Nature*. Becauſe the ſame *Temperament* is not always found in *Living things*, but is changed according to the variety of *Ages*, or the ſeveral Stages of *Life*. For in *Animals*, to every different *Age*, a different *Temperament* is appropriated; to *Childhood*, a *hot* and *moiſt Temperament*; to *Youth*, *hot* and *dry*; to *Manly Age*, *cold* and *moiſt*; to *Old Age*, *cold* and *dry Complexion*. And theſe *Temperaments* are therefore ſaid to be according to *Juſtice*, becauſe they of Property and Juſtice belong to ſuch and ſuch *Ages*.

IV. *The other according to Weight.* To this *Temperament* another is oppoſed, which is called a *Temperament* according to *Weight*, wherein all the *Qualities* are in an Equal poiſe; ſo as *Heat* doth not exceed *Cold*, nor *Cold*, *Heat*: *Moiſture* doth not exceed *Drought*, nor *Drought*, *Moiſture*; but are altogether equal in degrees. But it does not ſeem probable, that any Body is poſſeſt of ſuch a *Temperament*, neither is there any Cauſe aſſignable that might thus temper and poiſe theſe *Qualities*; and therefore this is a *Temperament* in Notion only, as *GALEN* ſaith, and not Real.

V. *The increaſe of Living things, is from Heat.* Foraſmuch therefore as *Heat* and *Moiſture* are required to a due *Vegetation* of *Living* Bodies, it happens, that according to the Exuperance of either of theſe *Qualities*, a more abundant production of *Living things* is occaſioned. Thus in *Summer time*, when *Heat* bears ſway, abundance of *Magots* breed in *Fleſh*, *Bees* in the Carkaſs of an *Heifer*, *Humming-Bees* or *Drones* in that of an *Aſs*, *Hornets* in that of a *Mule*, and *Waſps* in the Carkaſs of an *Horſe*: It is in the ſame Seaſon alſo, that *Dead Flies* recover *Life*. And accordingly it will not be difficult to give a Reaſon, why *Spices* grow only in *Hot Countries*, becauſe they ſtand in need of a great degree of *Heat* before they can arrive to that Purity, by a ſeparation of the *Heterogeneous particles*, that ſo the *Homogeneous* may come together, and conſtitute thoſe *Odoriferous* Bodies. And therefore, as my Lord *VERULAM* tells us, *Trees* planted on a *hot*-Bank, and expoſed to the South and South-Eaſt, do *bud* ſooner than others, and bring forth more early *fruit*. And the ſame he ſaith of *Trees* planted near the *Wall* of a *Chimney*, wherein continual *fires* are kept; and that it is good for the ſame purpoſe, to let the *Branches* of *Trees* ſpread into thoſe places where frequent *fires* are uſed. Of which we have a pregnant Inſtance in *Vines*, which according as they are more advantagiouſly ſituated, do by a whole *Months* time, ſooner than others, bear Ripe *Grapes*.

VI. *Dung, by its Heat, doth haſten the ſpringing of Plants, and makes the Ground fruitful.* It is for this very Reaſon, that *Country-men* do *Dung* their *Grounds*; not only becauſe the *Dung* doth fatten the *Earth*, whereby more plentiful Nouriſhment is conveigh'd to *Plants*; but alſo becauſe by its *warmth* it comforts and refreſheth the *Ground*, which was weak and languiſhing by reaſon of *cold*. For the *Dung* of *Animals* is *Salt*, and contains an *Inward heat*. And accordingly we find, that thoſe who deſire to haſten the *ſpringing* and *growing* of their *Plants*, do take care very well to *Dung* their *Gardens* and Plots of *Ground*, before they *ſow* their *Seed*. To this end alſo they pour ſtale *Urine* at the *Roots* of *Vines*, to make them more fruitful.

VII. *How Moiſture is a cauſe of the increaſe of Living things.* As ſtore of *Heat* doth conduce to the great increaſe of *Plants* and *Fruits*, ſo much *Moiſture* alſo is a great help to the multiplication of them, when

when accompanied with convenient *heat* and *warmth*. Thus we find, that in Moiſt places *Graſs* grows thicker, and riſeth to a greater height, than in Dry *Grounds*. In like manner we ſee, that *Herbs* will grow in *Glaſs Vials*, fill'd only with *Water*. We find alſo, that the *Hair* of *Young-men* and *Children* grows much faſter and thicker, becauſe *Moiſture* abounds in them: And *Trees* and *Plants*, that are much *water'd*, do thereby thrive the more; for by frequent *watring*, the Dryneſs of the *Soil* is temper'd, and the *Roots* are ſoftned, and thereby made more fit to ſuck the *Juice* out of the *Ground*, and to ſend it up to the utmoſt *Branches*. So the fitteſt time for the *watering* of *Plants*, is the *Evening*; becauſe the Cool of the *Night* following, gives the *Moiſture* leave to ſink down to the *Roots*, and refreſh them.

VIII. *Mouldineſs proceeds from Moiſture.* How greatly *Moiſture* conduceth to *Germination*, may be gather'd from *Moſs*, which delights in *moiſt places*, and grows even upon thoſe *Rocks* and *Stones* that are continually *water'd* with *Springs*. Hence it is alſo, that *Bread* that is kept in a *moiſt Cellar* grows *Mouldy*, and many other things that are laid up in *moiſt places*.

IX. *Heat, when exceſſive, is hurtful to Living things.* As an equal *Temperature* of *Heat* and *Moiſture*, is the Cauſe of the great increaſe and multiplication of *Living things*; ſo the Exceſs of either, and more eſpecially of *Heat*, is hurtful to them, and hinders them from arriving to their due *growth*. Thus we ſee that *Bodies*, wherein the inborn *heat* predominates, are of a low *ſtature*, becauſe it conſumes the *Moiſture* too faſt, not ſuffering it to ſpread and diffuſe it ſelf; and ſo alſo ſuch *Perſons*, in whom *Heat* abounds, are commonly *lean:* Whereas on the contrary, thoſe in whom this innate *Heat* is weaker, and allay'd with *Moiſture*, are apt to grow *fat*, and ſpread in *bulk*; as is evident in *Women*, who commonly are more Plump and Fat than *Men*, except *Sickneſs*, or any Præternatural Cauſe hinder the Effect.

CHAP. III.

The Death of Living things proceeds from contrary Principles, viz. *from Cold and Drineſs.*

I. *Wherein the Death of Living things doth conſiſt.* FOraſmuch as contrary *Effects* proceed from contrary *Cauſes*, we may eaſily conclude, That the *Death* of *Living Creatures* are owing to *Cold* and *Drineſs*. For as the *Bodily Life* conſiſts in the due Temperature of *Heat* and *Moiſture*; ſo *Death* happens to them through the predominance of *Cold* and *Drought*, whereby the *Vital Principle* of *inborn Heat*, becomes weakned and deſtroyed. *Bodily Life*, as hath been ſaid, conſiſts in continual *Motion*; wherefore when any Cauſe happens to fore-ſlow, or put a ſtop to this *Motion*, *Life* muſt ceaſe alſo. Now, ſince nothing is more oppoſite to *Motion*, than *Reſt*, wherein the Nature of *Cold* doth conſiſt, it cannot be queſtion'd, but that where *Cold* prevails, *Death* muſt enter. Thus we ſee *Flies* dye at the approach of *Winter*; and that *Frogs*, tho' they live in the *Water*, and are in a great meaſure habituated to *Cold*, yet periſh in *Froſty-weather*. For as great *Cold* doth congeal the *Waters*, and hinder their *Motion*; ſo the over-ſlow agitation of the *Spirits* and *Humors* in the *Body* of *Man*, is hurtful to the *Life* of the *Body*; and where it is of long Continuance, quite deſtroys the ſame. And in like manner alſo, exceſſive *Cold* cauſeth the dying of *Plants* and *Trees*.

II. *Cold drieth as well as Heat.* For tho' *Heat* and *Cold* be contrary *Qualities*, yet do they by oppoſite ways produce the ſame Effect, *viz. Drought*. For we find that *Clay* is dried by *hard Froſt*, as well as by great *Heat* in *Summer*: The Reaſon whereof is, becauſe all *liquid* and *moiſt Bodies*, loſe the agitation of their *Particles*, by *Cold*, and by this means become hard and dry: And therefore it is no wonder, if *Clay*, which is nothing elſe but a *Mixture of Water* and *Earth*, ſhould grow hard and dry, becauſe the *Water* which ſoftned it, is by the *cold* congealed. Seeing therefore that *cold* works the ſame effect in *Plants*, it cannot ſeem ſtrange to us if *Plants* periſh, when the *Juice* wherewith they were nouriſhed, is *frozen*. It has been of Old told us, that extream *Cold* ſcorcheth and burns up *Plants*, by congealing and drying up their *Moiſture* and *Alimentary Juice*.

III. *Why the Leaves of moſt Plants fall in Autumn.* Hence alſo it is, that in *Cold Countries* the *Leaves* begin to fall from the *Trees* towards the latter end of *Autumn*; becauſe about that time, the *pores* of *Plants* are ſhut up at the approach of *Cold*, and the Paſſages along which the *Juice* is conveyed, are dried up and contracted.

IV. *Heat is hurtful to the Aliment of Living Creatures.* And as *Cold* produceth theſe Effects in *Living Bodies*, ſo doth exceſſive *Heat* alſo; for *Heat* exhauſts the *Spirits* and *Humours*, and attenuates and waſtes the *Bodies* in which it doth predominate. For as a *Mill*, without the aſſiſtance of *Wind* or *Water*, ſtands ſtill without any *motion* at all; ſo *Plants*, upon the conſumption of their *Alimentary Juice, periſh*; and *Animals*, when their *Spirits* and *Humours* are weakned by extream *Heat*, languiſh and are ſlowly moved. Whence it comes to paſs, that when great *Heats* happen in *Hot Countries*, at the time when the *Ears of Corn* begin to break forth, they are ſtopped in their coming forth; becauſe the *Moiſture* being by the *heat* diſſipated into the *Air*, the *Heat* finds nothing to feed upon, or whereby to maintain it ſelf.

V. *When the Death of Living Creatures happens.* The *Death* therefore of *Living Bodies* happens, when *Moiſture*, which is the *food* and *fewel* of *Heat*, is waſted; or when *Heat* is ſeparated from, and leaves the *Moiſture*, which then ceaſeth to be agitated, and diſtributed to all *parts* of the *Living Body*. For as *Fleſh* laid before a ſlow *fire*, is *roaſted*, and by exhaling of the greateſt part of its *moiſture* becomes quite dried up; ſo the Temperament of *Living Bodies* becomes ſpoiled, when the *Spirits* and *Humours* are alter'd and waſted by exceſs of *Heat*. Thus *Fruits* are frequently ſpoil'd by over-much *heat*, which ſcorching their outſide, leaves their inward *ſubſtance* raw and unripe; as it happens to *Grapes* and other *Fruits*, whoſe outſide is often ſcorched with that *heat*, which ſcarcely toucheth their *Inward parts:* As *Bread* put into an *Oven* that is over-heated, hath its *Cruſt* burnt up and ſcorched, whilſt the midſt of it wants *baking*, and is *dougby*.

VI. *How Fiſhes are dried up in the Water.* But you'l ſay, If *Drineſs* be the Cauſe of *Death*, how can *Fiſhes* that live in the *Water*, ever arrive to that degree of *Drought*, which may cauſe their *periſhing* or *death?* I anſwer, That the *Water* in which the *Fiſhes* ſwim, cannot hinder the waſting and drying up of their *Natural moiſture:* As

we find that *Flesh*, which is suffer'd to *boil* in a Pot full of *Water*, till all the Natural moisture be consumed, becomes harder than that which is *roasted*. Yea, we find also that some sorts of *Wood*, that have lain long in the *Water*, are found drier and lighter when they are taken out, than when they were put in.

VII. *Excess of Heat is an Enemy to all Bodies.*

Neither is excessive *Heat* only an Enemy to *Living Bodies*, but even to all in general: Thus we find that when the *flame* of a *Candle* or *Torch* is increased, it doth so much the sooner consume and waste the *Body* that serves it for *fewel*; and by a parity of Reason, when the *Heat* either outward or inward exceeds, it procures the *Death* of *Living Bodies*: As we find that *Plants* wither by excessive *heat*; and that *Men*, by indulging themselves in the *drinking* of *hot Liquors*, do hasten their own *Death*.

VIII. *Death sometimes is caused by the want of Food.*

Sometimes *Death* happens to *Living Bodies* by *defect* of *Food* convenient; as when *Nature* ceaseth to furnish them with *Matter*, whereby they might grow and be nourished: For so in *Plants*, tho' it may be there wants no *Moisture* for the *Heat* to act upon, and tho' the *Sun* have force enough in *Summer time*, to draw up the *Juice* out of the *Earth*; yet is not that *Fervescence*, or *Fermentation* of the *Alimentary Juice*, which is requisite to their *Vegetation*, always performed alike; for it requires a certain and determinate Season of the *Year*, which being once past, it cannot afterwards be expected. An Example whereof we see in *Quick-Lime*, which upon the affusion of *Water* causeth an *Effervescence*; but that being once ceased, it cannot be renewed again, tho' you should pour never so much *water* upon it. And for this cause it is that *ripe Fruits*; as *Apples*, *Pears*, *Plums*, *&c.* do fall down to the Ground, as soon as their *Stalk*, whereby they were joyned to the *Tree*, begin to want *aliment*, and those *fibres* that held them fast are dried up. And the same is the Reason, why all other *Fruits* and *Grains* fall out of their *Husks* and *Pods*.

IX. *The Destruction of Bodies, is sometimes caused by a too great opening of the Pores.*

And much like Effects do sometimes proceed from the too great relaxation and opening of the *Pores* of *Bodies*: For thereupon the *Bodies* contained in those Intervals must needs fall down, except that by some means or other their *bulk* be coextended to the amplitude of the *pores* wherein they are. Thus, when in the *Summer Season* the *pores* of the *Skin* are more open, the *Hides* of *flay'd Beasts*, have the *Hairs* more easily pluck'd off. Thus likewise it seems probable, that the falling out of the *Teeth* of *Children*, is caused by the dilatation of the *Sockets* of the *Jaw-bone*, wherein the *Teeth* are fixed; for they growing wider, as the *Child* advanceth in bigness, they can no longer keep the *Teeth* steady. But in *Old People* this falling out of *Teeth* is caused by the defect of *Aliment* and *Moisture*; because the *fibres*, through which the *Aliment* was used to be convey'd to them, grow dry and are contracted.

CHAP. IV.

What is the Cause of that Hardness, which is observ'd on the outside of living Bodies.

I. *Whence the Hardness of the Surface of Living Bodies doth proceed.*

THe *Hardness* of *Bodies* consists chiefly in this, that they resist the *Touch*, and that their *parts* are not easily separable from each other. And forasmuch as this Resistance to the *Touch* is perceiv'd on the outside of *Living Bodies*; it will be worth our enquiry, What might be the Cause of it, that when their Inward substance is so soft, their outside should be hard. Whereof no other Cause seems assignable, but this, That the Outward parts of *Living Bodies*, are expos'd to the continual impulse of other *Bodies*. For it is certain, that the *Heavenly matter* (under which Name we do not only comprehend the Matter of the *first* and *second Element*, but also the *Air*, with the *Particles* of the *third Element* that are mix'd with it) carries the *Earth* round; and forasmuch as all these Small *Bodies* cannot pass through the *Earth*, or any of the *Bodies* which belong to it, it cannot be otherwise, but that vast numbers of them must dash against *Living Bodies*, and by their continual beating upon them, render them *hard*. For by this impulse, their Outward parts are driven closer together, and so become more Compact and Hard.

II. *Wherein the Hardness of any Bodies doth consist.*

For to speak properly, the *Hardness* of *Bodies* is nothing else, but the *Rest* of many *Essential* or *Integral parts*, caused by the Pression of the *Air*, or of the *Subtil matter*; which acting only on the outside, doth so much drive those *Particles* inwards, that they can no more be separated, without a perception of some Resistance. For tho' the *Subtil matter* doth penetrate all *Bodies*; yet we are to consider, that the Parts of many *Bodies* are so great and irregular, that they are able to resist its Action and continue at *Rest*, and by this means constitute *Hard Bodies*; because they resist or oppose their being divided, and are outwardly so compress't by the *Air* and the *Subtil matter*, that it is oftentimes more easie to move them altogether, than to separate them from one another.

III. *Whence the Covers of some Living Bodies do proceed.*

This is the Cause of those Coverings, which do invest some *Living Bodies*; as we find that *Acorns* have *Cups*; *Nuts* have *Shells*; *Beans* and *Pease*, *Pods*; and *Trees*, *Barks*: So likewise *Fish* have *Scales*, and some of them hard and stony *Shells*; as *Oysters*, *Crabs*, *Lobsters*, *&c.* All which without doubt are formed, by the continual impulse of outward *Bodies*; much in like manner as we find, that the *Palms* of the *Hands* of *Delvers* and *Ditchers*, by continual handling of the *Spade*, grow very hard; and as the *Soles* of our *Feet* become brawny and thick Skin'd, by assiduous beating against the Ground.

IV. *The same is the Cause of the Hardness in Inanimate Bodies.*

They are the same *Causes* also that produce *Hardness* in *Inanimate Bodies*. For *Snow* laid near the *Fire* becomes harder and more compact; and the outside of *Bread* becomes hardned to a *Crust*; and so likewise the outside of *Flesh roasted*, *broiled*, or *fryed*, grows harder than the inside. Neither can any other Reason be given, why *Broath*, *Boil'd Milk*, and other kinds of *Supping Meats*, presently after they are removed from the *Fire*, get a *skin* or *film* on the top of them, but this, that the agitation of the *Heat* is diminished by the contact of the *cold Air*, and in a manner quite stopt.

V. *Th Surface of Water is smooth, and more difficultly divided than its inward parts.*

Hence it is also, that the *Surface* of all *Liquors* is smooth and even; for tho' the Parts of *Water* be uniformly moved, as well as the *Air*, which immediately toucheth them; yet because the *parts* of the *Water* are moved after another manner, than those of the *Air*; and that the *Subtil matter*

matter which ſurrounds the parts of the *Air* is quite otherwiſe moved than that which *ſwims* amongſt the *particles* of the *water*; by this means the *ſurface* of either of them becomes *ſmooth*, much after the ſame manner as when two Hard *Bodies* are rub'd againſt one another; only with this difference, that this ſmoothneſs is with much more eaſe produced in liquid *Bodies*, becauſe of the eaſie and ready Mobility of their *Parts*. And this is the reaſon alſo why the *ſurface* of the *water* is divided with more difficulty, than its inward parts.

VI. *The Hardneſs of Bodies ſometimes proceeds from Cold.*

Cold alſo conduceth much to the *Hardning* of *ſeveral* Bodies: for we ſee that the *ſurface* of *water* in a *River*, by *cold* is congealed, whilſt that which is at the bottom, by reaſon of the ſtronger motion of *heat*, ſuffers not the leaſt alteration; and ſo alſo are many other *Bodies* ſometimes hardned by *cold*, and thereby attain that degree of firmneſs, which is cauſed in them, by other *Bodies* beating upon them: For *frozen Fruit*, if it be put into cold *water*, and ſet in a *warmiſh place*, will appear covered over with a *Cruſt of Ice*, and in like manner the *Fleſh* of *Beaſts* or *Fiſh* that is *frozen*, if it be ſet in a warm place covered with *Snow*, there will appear a hard Cruſt of *Ice* on the *ſurface* of it.

VII. *But more naturally from Heat.*

But tho' *cold* may ſometimes contribute to the hardning of *Bodies*, yet this effect may with greater Right be attributed to *Heat*, whoſe property it is to agitate the parts of *Bodies*, and bring them cloſer together, by exhaling their ſuperfluous *moiſture*. Thus a *Body* expoſed to the *Beams* of the *Sun*, as by this means it becomes better digeſted and riper; ſo likewiſe it attains a greater degree of firmneſs and hardneſs. This is manifeſt in *Apples*, *Pears*, *Cherries*, *Plums* and ſuch like, whoſe outſide by the *Heat* of the *Sun* becomes hardned, and covered with a *Skin*.

VIII. *All theſe ways are reducible to one general way of Hardning of Bodies.*

But which way ſoever this *Hardneſs* may be produced in *Bodies*, it ſeems that they are all reducible to one general Cauſe, foraſmuch as their outward *parts* endure the impulſe of other *Bodies* ruſhing againſt them and daſhing upon them, and by hindring their ingreſs, do reſiſt and beat them off.

CHAP. V.

Of the Different Degrees of Heat in Living Bodies.

I. *There is a different degree of heat in Living Bodies. Firſt according to the Diverſity of Age.*

THO' *Living Bodies* may be diſtinguiſht according to the *External Heat* that Acts upon them, as they are in *Countries* or *Places* nearer or farther from the *Sun*: yet may they much better be differenced by that *Internal Heat*, which produceth divers *Effects* in them with relation to their *Age*, *Sex* and *Nature*. For as to their *Age*, it is evident that *Heat* in *Living Bodies* is not always in the ſame ſtate and vigor. For in *Infants* and *Youth* the natural *Heat* is much weakned by the abundance of *moiſture*, that it cannot exert its full ſtrength; which is the reaſon why *Infants* are ſo prone to *ſleep*, and apt to ſhed *tears*. But in the Height and *Vigour* of *Age*, the *Heat* is more ſtrong and active; and the *moiſture* being much leſſened, the *Spirits* become more hot and fiery. For which cauſe thoſe who have attained to *Manly ſtrength*, are more ſtrongly inflam'd and *Amorous*, whereas in *Old Men*, by the decreaſe of *heat*, and the increaſe of *cold* and *drineſs*, their *natural faculties* are much weakned and decayed.

II. *Secondly according to the difference of Sexes, and what the difference of Sex in Plants is.*

Difference of Sex alſo produceth great diverſity of *Heat*; for *Females* are commonly of a more *cold* and *moiſt* complexion than *Males*. Which difference is obſerved in *Plants*; for thoſe are accounted *Female Plants*, which are more *cold* and *moiſt*, and have leſs *virtue* and *ſtrength*; ſo that tho' they bring forth *Flowers*, yet for want of *Heat* they don't produce either *Fruit* or *Seed*. Whereas the *Male Plants* are more *beautiful*, as to their outward appearance, and have both *Fruit* and *Seed*. And for this cauſe it is, that the *Female Plant* delights in the Company and Proximity of the *Male*; according to what *PLINY* relates of the *Palm-tree*, which by ſome influence proceeding from the *Male*, doth conceive and become fruitful, and as ſoon as the *Male*, which ſtood near it, is cut down, dies preſently.

III. *Amongſt Animals the Females are colder than the Males.*

Amongſt *Animals* alſo the *Females* are much colder and moiſter than the *Males*. As may be gathered from hence, that *Males* generally exceed *Females* in Bulk and Stature, as appears in *Men*, *Pheaſants*, *Peacocks* and the like. The *Males* in *Birds* are commonly more beautiful and pompous for their *Feathers*. Amongſt *fourfooted Beaſts* the *Males* and *Females* are diverſly diſtinguiſht; thus *He-Goats* have *Horns*, which their *Females* want; and *Rams* have greater and more crooked *Horns* than the *Ewes*. *Cocks* are adorned with *Combs*, and armed with *Spurs*; whereas *Hens* have in a manner no *Combs* at all. And in general all *Males* have a ſtronger and deeper *Voice* than *Females*, who generally have but a ſhrill and weak voice. All which effects cannot be better aſſign'd to any other cauſe, than to the greater degree of *heat* which is in *Males*, beyond that which is in *Females*. And the ſame may likewiſe be gathered from hence, that *Males*, in their tender *years*, whilſt their inborn *heat* is overpowered with too much moiſture, do much reſemble *Females*, neither is any difference in their Temper to be diſcern'd between them. So likewiſe *guelded Animals* do more reſemble *Females*, for the ſame defect of *heat*.

IV. *Why Men in the Winter time are more brisk, and Women in Summer.*

Another inſtance of this diverſity of *Heat* in *Males* and *Females* is this; that *Men*, during the *Winter Seaſon*, are more *Brisk*, and *Women* on the contrary, in the *Summer* and hot weather. The reaſon whereof is, becauſe the *Vital Spirits*, which are in continual *motion* in a *hot* and *dry complexion* of *Body*, ſuch as *Mens* are in the *hot ſeaſon* of the *Year* are more diſſipated; but in a *cold ſeaſon* are more condenſed, and thereby better preſerved. Whereas in *cold* and *moiſt Bodies*, ſuch as thoſe of the *Female Sex* generally are; the *Heat* of the *Summer* cheriſheth and excites the *Spirits*; and the *cold* of the *Winter* doth render them dull and ſluggiſh.

V. *Of the four degrees of Heat that are in Living Bodies.*

There is alſo a diſtinction and difference of *Heat* with relation to the different kinds of *Living Things*. And accordingly *Phyſicians* diſtinguiſh *Heat* into 4 degrees: They call that the *Firſt Degree* of *Heat*, when that *Quality* is ſomewhat predominant above the reſt that are in the mixt *Body*: The *Second* when the *Heat* ſenſibly diſcovers its predominance in the *Body*: The *Third*, when it ſtrongly and powerfully diſplays it ſelf:

ſelf: And the *Fourth* when that *Quality* is prevalent in the higheſt degree. Thus amongſt *Plants*, *Borage*, *Flowers of Betony*, *Beets*, *Sweet Almonds*, &c. becauſe they impart ſome ſmall effect of *Heat* to a well tempered *Body*, are ſaid to be *Hot* in the *Firſt Degree*. *Smallage*, *Betony*, *Balm*, *Roſemary*, *Wormwood*, *Saffron*, *Sage*, *Cinnamon*, &c. becauſe they produce a moderate *Heat*, and that very ſenſibly, are called *Hot* in the *Second Degree*. And becauſe others impart a ſtrong *Heat* to thoſe that take them, as *Origany*, *Hyſop*, *Celandine*, *Mints*, *Radiſh*, *Mother of Tyme*, &c. they are accounted *Hot* in the *Third Degree*: And laſt of all, becauſe *Garlick*, *Pepper*, *Muſtard*, *Creſſes*, *Pellitory of Spain*, &c. communicate a much more vehement degree of *Heat*, they are called *Hot* in the *Fourth Degree*.

VI. *Animals are diſtinguiſht according to their ſeveral degrees of Heat.*

This Diſtinction of *Heat* is not only obſervable in *Plants*, but alſo in *Animals*. For we ſee daily that thoſe Excrements which remain after that the *Meat* hath been digeſted by the heat of our *Stomachs*, ſerve for *food* to *Hogs* and *Hens* after having paſt through a new *Fermentation* in them; and that the remainders thereof being laid to the *Roots* of *Plants*, are conſumed again by the *Heat* of the *Sun*, leaving only the groſſer parts behind them. Which different changes could not be wrought upon thoſe *Excrements*, if there were not different degrees of *Heat* in the *Bodies* of *Living Creatures*, foraſmuch as that which can no further be wrought upon by the *Fermentation* of our *Stomachs*, may yet be further altered and digeſted by a new *Fermentation* in the *Stomachs* of other *Animals*. Thus a *Maſs of Dough* that hath been fermented by *Leaven* or *Yeſt*, tho' it cannot be made to riſe again with the ſame *ferment*; yet may it for all that undergo a new *Fermentation* in our *Stomachs*: Which *Alterations*, I ſay, do prove a diſtinction of *Heat*, and a different power of diſſolving *Bodies* to be in *Living Creatures*.

CHAP. VI.

The Virtue and Nature of Aliments remain in the Bodies that are Fed and Nouriſhed by them.

I. *The whole Aliment is not changed into the ſubſtance of the thing nouriſhed.*

THO' *Aliment* or *Food* in *Living Bodies* be digeſted by the *Natural Heat*, and by that means becomes changed into their nature, yet it is not ſo entirely aſſimilated to them, as not to retain ſome of its former *Nature* and *Virtue*. This appears from our *Excrements*, which tho' by the *heat* of our *Stomachs* they have been ſeparated from the thinner parts of our *meat*, and as it were changed into a quite different *ſubſtance*, yet retain ſomething of the *virtues* and *qualities* of thoſe *Bodies* whence they have been ſeparated, and often preſerve ſomething of their *colour* and *ſmell*. Thus they who eat any quantity of *Black Cherries* or *Myrtle Berries*, will find their *Excrements* ting'd of a *Black Colour*. And *Sparagus* and *Turpentine* after having paſſed through the *Stomach* and other *Organs* of *Nutrition* communicate their *Odour* to the *Urine*.

II. *Some part of the Aliment is kept or remains with the Body that is fed.*

If therefore ſo great *virtue* of the *Food* do ſtill remain in the *Excrements*, with much more reaſon may we conclude, that the ſame much more abides in the *Bodies* that are nouriſht by, and receive their encreaſe from them; foraſmuch as the more pure and *Juicy* part of the *Food* abides with them, which doth moſt abound in *virtue*. And tho' *Animals* void many *particles* of their *Aliment* by *Siege*, by *Urine*, by *Sweat* and by *inſenſible Tranſpiration*; yet cannot this hinder us from concluding that many *Particles* of *Aliment* muſt remain in the *Bodies* of thoſe *Animals* that are nouriſht and grow by it. Hence it is that *Country People* that feed upon *Beef*, *Bacon*, *Cheeſe*, and ſuch like ſtrong *Food*, which nouriſh much, but are ſomewhat hard of Digeſtion, are much more ſtrong in *Body* than thoſe who *feed* upon Dainties, who generally are weak and unfit to endure labour. Who doth not find in himſelf a different ſtate of *Body* when he *drinks Wine*, than when his ordinary drink is *Beer*, *Ale* or *Water*? And do not thoſe that that fare deliciouſly and *feed* high, find themſelves more ungoverned in their Paſſions and *Luſts*, than thoſe who live abſtemiouſly, and content themſelves with neceſſary *Food*?

III. *Milk is differently qualified according to the difference of the Paſture the Cows graze in.*

The virtue of *Aliment* is more particularly diſcernible in the *fruits* and products of *Plants* and *Animals*, which differ, according to the diverſity of the *matter* whereof they are formed. Thus *Milk* is not always qualified alike, but according as the matter of it is drawn from ſuch or ſuch *Plants*, its *virtues* and *qualities* vary. *Cows* that feed upon *Graſs* yield a very different *Milk* and *Butter* from thoſe that eat *Straw*. It is a matter alſo of common Experience, that *Cows* that in their feeding light upon *wild Garlick*, communicate a ſtrong taſt of *Garlick* to their *Milk*; and that the fleſh of *Sheep*, which feed upon *wild Thyme* hath a much more grateful *taſt* than that of others. *GALEN* makes mention of a certain *Medicinal Milk* which is very prevalent in the cure of the *Schirrus* or hard *ſwelling* of the *Liver*; the *Cow* that yields it being made to feed on ſome peculiar *Herbs* conducing to that end. The ſtory alſo of that *Young Woman* is well known, who having uſed herſelf to the eating of *Wolfs bane* (which is a moſt poiſonous *Herb*) tho' ſhe found no hurt by it herſelf, yet was the death of thoſe *men* that lay with her.

IV. *Herbs after they are turned to Blood retain their purging virtue.*

Phyſicians likewiſe do obſerve, that if the *Milk* of a *Goat*, that hath fed upon ſome purging *Plant*, be eaten by a *Nurſe* that ſuckles a *Child*, it will communicate its purging *virtue* to the *Nurſes Milk*, and purge the *Child* that ſucks it. It is known alſo that the *Milk* of *Cows*, and the *Butter* made of it is far better in the *Spring*, when *Cows* feed upon tender *Herbs* and *Flowers*, than at other times. So likewiſe it is obſerved that the *Honey* which the *Bees* gather from *Thyme*, *Sage*, *Savory* and *Tree Trefoile*, being the *Herbs* they moſt of all delight in is the beſt of all other. For this reaſon the *Honey* of *Sardinia* hath a bitter *taſt*, becauſe it is moſtly gathered from *Wormwood*. And *Hiſtorians* tell us, that the *Honey* made about the City *Heraclea* in *Pontus*, had a venemous quality, becauſe it was gathered from the poiſonous *Aconite*.

V. *The Ground or Soil in which the Vines grow, communicates to the Wine ſome of its virtue.*

The ſame may be alſo experienc'd in *Wine*, which being adulterated with *Quick Lime*, *Plaiſter of Paris*, *Rocket*, *Wild Myrtle or Butchers Broom*, *Jews Lime*, *Clary* and the like, becomes pernicious to the *Body* of *Man*. There are alſo ſome ſorts of *Wine* which do particularly affect our Diſpoſitions.

tions. It is an Observation of *LEMNIUS*, that the Common People in *Holland*, by their much *drinking* of *Poitou Wine*, which sends sharp Fumes up to the *Brain*, are thereby inclined to be very peevish and quarrelsom; whereas those of them that drink *Rhenish Wine*, are not so. And it is observed, that the *Fruits* and *Plants* which are the product of *dung'd Grounds* are not so good and wholsom, as those that grow, where no such Art hath been used: As likewise, that the *Grain* or *Pulse* that grows on such *ground*, cannot be so long kept from becoming *musty*, or being eaten by *Worms*; and that the *Beer* brewed of such *Grain* doth sooner turn Sower.

VI. *Living Creatures retain the Qualities of their Aliment.*

The *Virtue* of *Food* is also perceiv'd and distinguish'd in *Animals*. For in some parts of *Holland*, which is a *Watry Country*, and abounding with *fish*, they fatten their *Hogs* with them; which tho' they soon fat them, yet it is observed that the *Flesh* of these *Swine* is more flaggy and less firm, neither is it so wholsom; and differs much in Taste from the *flesh* of those *Swine*, which have been fed with more convenient *Aliment*: Because *Fish*, as *GALEN* observes, generates a thinner *Blood*, and more Excrementitious, than the *flesh* of *Terrestrial Animals*.

VII. *Many Diseases arise from the Qualities of Food.*

So likewise from the *Qualities* of *Aliments*, remaining in the *Body* of *Man*, many *Diseases* are generated; as the *Scurvy*, the *Gout*, *&c.* Thus we find that the *Scurvy* is an *Epidemical Disease* in those *Countries*, where they eat *Meat* much *salted*, and dried in the *Smoak*, and brew their Beer of *Brackish Water*. And those are commonly troubled with the *Gout*, who live intemperately and luxuriously, especially if they feed much upon *salt Meats*, and drink much *Wine*. For as the Learned *Dr. WILLIS* observes in his *Pathologia Morborum*, by this means a raw and indigested *Chyle* is prepared; and then, by the intemperate *drinking* of *Wine*, those *Saline Dregs*, which otherwise would go to the Excrement, and be carried forth with them, being too much exalted, are conveyed into the *Blood*: To which Enormities of *Diet*, if a *Sedentary Life*, *Idleness*, and *Sleeping after Dinner* do concur, whereby those Superfluities are hindred from exhaling, or being discust by Labour and Exercise, they will the more certainly produce the *Gout*, and that in the worst manner.

CHAP. VII.

Living things do vary and alter, according to the difference of Place and Time.

I. *What the Alteration or Change of Bodies imports.*

A *Body is* said to be *alter'd*, *when it suffers any change in the figures of its Sensible or Insensible parts*; *or when it loseth some Parts, and acquires others.* Thus a *bruised Apple* is said to be changed or *alter'd*, because many of its *parts* have acquired another *Position*; and some of them may have quite changed their former *figures*. This *Alteration* is caused two several ways in *Living Bodies*, either by being removed from one place to another, as from a *hot* to a *cold Country*; or on the contrary; or by the different *Seasons* of the *Year*, which is the diversity of *Time*.

II. *The Difference of Countries contributes to the variety of Living things.*

Living things, that are removed from one *Country* to another, are by this means variously alter'd, being sometimes meliorated, and sometimes again degenerating, as the *Climat* doth agree, or disagree with them: And this, because of the difference of *Heat* and *Cold*, *Moisture* and *Dryness*, that predominates in those *Countries*; for according as the *Climat* or *Soil* of any *Country* differs, so the disposition of those *Bodies* that are there differ also. Thus some *Plants* grow much taller and fairer in some *Countries* and *Soils*, than in others. Some *Plants* being removed to a better *Air* and *Soil*, are thereby meliorated and bring forth wholsom *Fruits*; whereas in their *Native Soil*, they brought forth *deadly* and *poisonous Fruits*. As *COLUMELLA* acquaints us with a certain *Plant*, which by being removed from *Persia* to *Egypt*, loseth its venemous *Quality*, and becomes wholsom to those that *eat* it.

III. *Herbs vary according to the diversity of the Soil or Country where they grow.*

Thus *Herbs* that grow in *Barren Grounds*, are very different from those that grow in a rich and fat *Soil*, which are far more large and fair, than the former. Thus *Bugloss*, *Comfry* and *Avens*, change the *colour* of their *Flowers* by the Industry of *Gardiners*, and the Fruitfulness of the *Soil* where they are planted. *Violets* also, whose Natural *colour* is *Purple*, are changed into a *Blew*, when they grow in rich Ground. In like manner, some *Plants* that are armed with *Thorns* and *Prickles*, being transplanted to some certain places, lose much of their *Pricklines*.

IV. *Plants degenerate, when transplanted from a fruitful Soil, to a barrin.*

And on the contrary, *Plants* removed from a fat and rich *Ground*, to a dry and Barren place, do frequently degenerate. So we find that the *Plants* brought from the *Canary Islands*, and other *hot Countries*, if they be planted in our *Northern Climat*, lose much of their *genuine Virtue* and excellence; as we see in the *Herb* called *Master-wort*, which tho' it retain the same outward shape and appearance, yet differs very much in force and virtue, from what it is in those *hotter Countries*. Yea, it is reported by some, that the *Earth* brought from the *Fortunate Islands*, and other far distant *Countries*, into *Italy*, hath brought forth several strange *Plants*, different from those that grow in *Europe*.

V. *All Plants have particular places which they delight in.*

All kinds of *Plants* affect some particular *Climat* and *Soil*, and especially those places where they sprung up at first, whence they cannot be removed without danger of being prejudiced thereby. For some love *shady* and *moist places*; others, *high grounds*, and expos'd to the *Sun*; some delight in *morish* and *fenny Ground*, others in *dry* and *sandy*; which, if they be removed from these places, lose much of their *virtue* and *fairness*. Those which delight in *hot Countries*, will not grow in those that lye far North; neither will those that thrive in *cold Countries*, live under the *Torrid Zone*. Thus *Wormwood* grows plentifully in *Pontus*; *Orrus*, in *Dalmatia*; *Hellebore*, in the Island *Anticyra*; *Sea Purslan*, on the *Sea shoar*. *VIRGIL*, in the Second Book of his *Georgicks*, does elegantly set this forth:

All Grounds not all things bear, the Alder-*Tree*
Grows in the Fens; *with* Sallows *Brooks agree*;
Ash, *craggy Mountains*; *Shoars sweet* Myrtle *fills*;
And lastly, Bacchus *loves the Sunny Hills.*

VI. *Those that thrive in Hot Countries, commonly dye in Cold Countries.*

For the Plants that thrive in *Arabia*, the *East* or *West Indies*, *Brazile*, *&c.* being transported to *France*, *Flanders*, or *Germany*, do not grow there without great Pains-taking, and after all do not answer the *Virtues* of those that grow in those *hotter Countries*. Yea, the curious lovers of *Plants*, when they transplant any *Herbs* or *Trees*, take diligent observation of their standing in the *places* where they Naturally grew, what part of them was turned towards the *Pole*, *&c.* that they may set it again in the very same manner as it stood before; because they suppose that the change of their former *situation* may very much hinder the thriving of them, and *spoil* the inward disposition of their Parts. See the *History of Nature*, *concerning* Plants, Chap. VI.

VII. *Change of Place is the Cause of Alteration in Animals also.*

Much a like Alteration we shall also find in *Animals* that are transported from one place to another. For we find that *Youths*, upon any considerable changing of the *Air* wherein they were born, do shoot up strangely in a few Months time, more than they would have done, had they continued at home in several *Years*. Others again, upon changing of their *Native Soil*, do grow thin and meager, and lose their fresh and lively *colour*. It is also notorious, that some persons have an Antipathy against some *places*, because that where they were born is of a quite opposite Temperament.

VIII. *Difference of Time and Season, is the Cause also of alteration in Living Bodies.*

Neither doth the Difference of *Time* occasion a less change in *Living things*, than that of *Place*. For tho' *Plants* be nourished all the *Year* through, yet do not they always shew forth the same effects of their *Nourishment*; for during *Winter* they are divested of their *Leaves* and *Seeds*, excepting only some few, *viz.* the *Bay-tree*, the *Yew*, the *Ivy-bush*, *&c.* which by reason of the *clammy Juice* where with they are nourished, do not shed their *Leaves*, as the rest do. Accordingly also Care is taken, that such *Seeds* which can endure the *Frosts* of *Winter*, be sown in *Autumn*; and others again at the beginning of *Spring*, or a little before the *Humour* begins to move, lest by the too abundant affluence of it, the *Roots* should perish. For as some *Seeds* are spoiled for want of *Moisture*, so others perish by an overplus of it. *Fruits* also are subject to *Alteration*, according to the several *Seasons* of the *Year*, most of which are only *green* in *Summer*, but attain perfect maturity in *Autumn*, and losing their former *taste*, *smell*, and *colour*, do acquire new *Qualities*, and accordingly affect our *Senses*.

CHAP. VIII.

Of Plants; and first of all of their several Parts.

I. *The Parts of Plants are either Simple or Compound.*

HAving hitherto spoke of *Living Bodies* in *General*, we come now to the handling of *Plants* in *Particular*, to the end that having explained their *Nature*, what we have to say concerning *Animals* may be the more readily understood. The first thing to be considered in *Plants*, is their *Parts*, which are either *Simple* or *Compound*. I call those *Simple parts*, *which consist of Particles of the same Texture and Constitution*; such as are the *Juices* or *Liquors* contained in them. The *Compound parts* are those that *are made up of parts of a different Nature*; and are also called *Organical parts*, because they concur to some one *Action* or other; as the *Root*, *Stalk*, *Leaves*, *Flowers*, *&c.* Some whereof are *Perficient* and *Integral*; others *Conservative* of the kind; others *Ornamental*, and others *Defensive*. The *Parts* belonging to the *compleating* and perfecting of a *Plant*, are the *Root*, and *Stem* or *Stalk*; those that concur to the *propagating* of their *kind*, are the *Fruit* and *Seed*; and those that *defend* them from the Injuries the *weather*, and otherwise, are the *Bark Tho* of or *Prickles*, *Shells*.

II. *The Simple parts of a Plant.*

The *Simple* or *Similar parts* are the *Juice*, or *Moisture*, the *Nerves*, the *Windpipe*, and the *Flesh* of *Plants*.

III. *Juice or Moisture.*

The *Juice* or *Moisture*, *is the liquid part of a Plant*, *diffused through the substance of it*. This *Juice* is, as it were, the *Blood* of the *Plant*, which if it chance to burst through any part of it, whether of its own accord, or by the *heat* of the *Sun*, or by cutting or lopping of the *Plant*, is called a *Tear*, because it breaks out of the *Tree* like a *Tear*, or *Drop*. Which *Drops* are twofold: The first are such as are of a *Watry Nature*, having something of an *Earthly* consistence joyn'd with them, and are called *Gum*; which is that congealed and thick *Liquor*, that proceeds from the *Trunks* of *Trees*, and cleaves to the *Barks* of them; and the other more oily and fat, which is called *Rosin*.

IV. *The Nerves or Sinews.*

Nerves in a *Plant*, are those *fibres* or *strings*, which give consistence and strength to the softer Parts of a *Plant*; and *by which the Alimentary Juice ascends*. The *Spirit* contracts the *fibre* or *string*, and so drives the *Moisture* upwards, which descends through the little *Bougets* or *Membranous passages*. For in every *Plant*, besides the *Sensible Body*, there is a *Subtil vigorous Body*, the Producer of *Motion*, *viz.* the *Spirit*, which runs through the whole *Body* of it.

V. *The Wind-Pipe.*

The *Trachea* or *Wind-pipe* of a *Plant*, being also a *Similar part*, is an open and wide *Vessel*, consisting of little thin *Plates*, ranged like the *Scales* of a *Fish*, or writhen and twisted together, being for the most part of a *Silver colour*; and may be easily stretched, prest and bent. In the *Trunk* or *Stem* of a *Tree* they run upwards; in the *Leaves* they are made like a *Net*, and take up great Spaces in them; in the *Sprouts*, *Buds*, and *Shoots* they are twisted, and are called by a Learned Man, *Vasa spiralia*, *Spiral Vessels*.

VI. *The Flesh.*

The *Flesh* is another *Similar part* of a *Plant*, which is *thick*, but somewhat soft, and is outwardly cover'd with the *Bark*: Of which hereafter.

VII. *The Compound Parts.*

The *Compound*, or *Dissimilar parts* of a *Plant* chiefly, are the *Root*, the *Stem* or *Stalk*, the *Bark*, the *Pith*, the *Branches*, *Leaves*, *Flowers*, and *Fruits*.

VIII. *What the Root is.*

The *Root* is the lowest part of a *Plant*, sticking in the *ground*, through the *passages* and *pores* whereof the *Alimentary Juice*, being moved by *Heat*, is driven upwards. This *Part* is so necessary to *Plants*, that none can subsist without it. There is one kind of the *Herb* called *Chamæleon*, which wants a *stalk*; *Wheat* hath never a *branch*; the *Fig-tree* hath no *flowers*, *Jesamin* hath no *fruit*; but there is no *Plant* without a *Root*, nay, there are some that are nothing else but a *Root*, *viz.*

viz. a *Muſhrom.* For the *Root* is, as it were, the *Mouth* by which the *nouriſhment* is taken in, or like the *Hand* by which *Plants* draw *Juice* out of the *Earth*, and ſend it up into the *Trunk* or *Stem*. And to this end it is *porous*, and full of many looſe *paſſages* for the humour freely to aſcend that nouriſheth the *Plant*. The *Roots* are very different in their *Figures*, ſo that almoſt every different kind hath *Roots* of a different *figure*. In a *Fig Tree* and *Olive Tree* the *Root* is ſingle, and ſinks very deep, yet ſends forth ſeveral little *twigs* from the ſides of it. In *Leeks* and *Onions* the *Roots* are manifold, as conſiſting of innumerable ſhreads or *Hairs*; in *Turneps* it is *Round*; in *Beets* it is without *Joints*; in *Orris* it is full of *Joints*; ſometimes it conſiſts of many round *knots*, as in *Birthwort*. Yet all *Roots* generally agree in this, that they end in a *Cone*, or ſharp *point*; for the upper part of the *Root*, drawing to it ſelf more *Aliment*, doth grow to a greater bulk than the lower part.

IX. *The Trunk or Stock.* The *Stock*, *Trunk* or *Stalk* is that part of a *Plant*, which riſeth up from the *Root* above the *Earth*, and tranſmits the *Moiſture* it receives from it to the utmoſt parts of it. In *Herbs* it is properly called the *Stalk*; when it is hollow, it is called *Calamus* the *Reed*, and in *Corn Culmus*, the *Blade* or *Straw*, and in *Pulſe Scapus*, the *Shaft*. The *Stock* or *Stem* of a *Plant*, before it be turned in to *wood*, conſiſts of a *ſpungy ſubſtance*, ſomewhat ſoft, and full of a coagulated *Juice*, from the abundance whereof its *Green Colour* proceedeth. If the *top* of it chance to fall off, it grows ſo much the thicker, becauſe then it enjoys that part of the *Aliment* which was appointed for the *nouriſhment* of the *top*, and thereupon dilates its ſelf and grows bigger in bulk. It is common to the *Trunks* of *Plants* to become *crooked*, and to bend one way, when the *ground* begins to be dry and ſapleſs, and furniſheth a more hard *Alimental Matter*, than can be well digeſted by the *Tree*. Tho' the *Stocks* of *Plants* be generally *Cylindrical*, yet there are ſome that are corner'd: In *Daffodils* the Stalk is two-corner'd; in *Cyperus*, which is a kind of *Ruſh*, it is three-corner'd; and in *Horehound* the Stalk is 4 ſquare.

X. *The Bark.* The *Bark* is, as it were, the *Skin* or *Hide* wherewith the *Plant* is cover'd; and the ſame is manifold in one and the ſame *Plant*, *viz.* the *outward*, which reſembles the *Cuticle* or thin outward *Skin* in *Man*; the *middlemoſt* which is *thicker* like a *Hide*; and the *inmoſt* which is like a thin *Membran*. And therefore the *Bark* is reckon'd amongſt the *Diſſimilar Parts* of a *Plant*, becauſe it conſiſts of a great variety of *Strings* and *Fibres*, and of ſeveral *Coats*. For it is not the ſame in all *Plants*; for in ſome it is thick, as in the *Poplar Tree*; in others thin, as in the *Bay Tree*; in a *Reed* it is like a *Membrane*; in a *Vine Nervous* or *Sinewy*. In the *Spring* time the *Bark* is with eaſe ſeparated from the *Tree*, becauſe of the *Juice* that aſcends between it and the *Tree*, which diſſolves that Glew whereby it was before faſtned to the *wood* of it.

XI. *The Pith.* The *Pith* of a *Plant*, which by way of excellence is called the *Heart*, *Brain* and *Matrix*, is that middle part whereby the *Aliment* is conveighed from the *Root* to the upper parts. The ſame is alſo very different; for in ſome *Plants* it is ſoft and ſpungy, as in the *Elder Tree*, where it reſembles *froth*; in others again it is harder, as in the *Pine Tree*, whoſe *Pith* is *woody*. The *ſeminal virtue* of the *Plant* is ſuppos'd to be lodg'd in the *Pith*, foraſmuch as not only the *Branches*, but the *Fruit* and *Seed* are derived from it.

XII. *The Branches.* The *Branches* are the upper parts of a *Plant* which ſpread themſelves from the *Stalk* or the *Trunk* of a *Tree*, as ſo many *Arms* ſtretched forth, to which they are joined by a *glutinous ſubſtance* hardned, which they call *Nodus* or a *Knot*, and in their ſprouting forth from the *Trunk* make an *Angle*, which in Latin is called *Sinus*, reſembling the *Arm-pit*, or the joining of the *Arm* to the *Body*. In many *Trees* the *Branches* grow without any order, but in the *Pitch* and *Firr Tree* they appear in a curious and beautiful ranging; the thinner and utmoſt parts of the *Branches* are called *Sprigs*, which are more tender than the reſt of the *Branch*, having not long been expos'd to the intemperature of the *Air* or *Weather*. The ſwellings that appear in the *Joints* of them, are called *Buds*, as long as they continue round, and are not yet open'd. And the thin tops of the *Sprigs* are called *Sprouts*.

XIII. *The Leaves.* *Leaves* are the ornament of *Plants*, and the *coverings* of the *Flowers* and *Fruit*, ſhading them from the *Heat*, and defending them from the diſtemperature of the *Weather* or *Air*. They generally proceed from the more thin and tender part of the *Bark*: ſo that when the *Bark* is pluck'd from a *Bough*, we find that the *Leaves* ſtick to it, and are pull'd off together with it. Yea, if the whole hollow of the *Bark* be pull'd off from a *Branch*, and the lower part of it be put into *water*, in the *Spring* time, *Leaves* will ſprout forth from the upper part of it. The *Figure* of *Leaves* is manifold; for in ſome *Plants* they are large and broad, as in a *Gourd*; in others very ſmall, as in a *Pine Tree*; in ſome thick and fleſhy, as in *Purſlain*; in others nervous and full of *Sinews*, as in *Wheat*; in *Onions* they are hollow like a *Pipe*; in *Aloes* partly round, and partly angulous. The *Stalk* or *Stele* of *Leaves* is alſo various; in thoſe of an *Olive Tree* it is ſhort; that of *Vine Leaves* is ſomewhat long; in *Colts-foot* and *Herbs* that grow in *Ponds*, the ſtele of the *Leaves* is very long, becauſe in them it is inſtead of a *Stem* or *Stalk*. Sometimes only one Leaf grows upon one *Stele*, as in the *Poplar* and moſt other *Trees*, ſometimes more, whence thoſe *Plants* are called 3 *leav'd*, 5 *leav'd*, 7 *leav'd*.

XIV. *The Flowers.* *Flowers* which are the moſt beautiful product of *ſporting* Nature, do greatly conduce to the *Ornament* of a *Plant*. They conſiſt of a fourfold *ſubſtance*, or rather of ſo many *parts*, *viz.* of the *Knot* or *Cup*, the *Leaves*, the *Threads* or *Thongs*, and the *Stalk* or *Stele*.

The *Knot* or *Cup* is that part which covers the *Flower* and keeps the *parts* of it together; as being the Baſe and ſupport of it; and therefore is of thicker and ſtronger *ſubſtance*, and not ſo beautiful as the *Flower* it ſelf.

The *Leaves* of the *Flower* compoſe the *Body*, and Beauty of the *Flower* it ſelf, being remarkable for their *Tincture*, but very fading, and of a very tender Complexion and Texture.

The *Threads* are thoſe long and ſlender parts in the middle or *Navel* of a *Flower* like *Hairs* or *Threads*, which in ſome *Flowers* are thicker than in

in others, and often have little Spires at the top of them; and are set round about the *Stele*, which is a long, but thicker part of a *Flower*, rising up from the middle of the *Navel* of it.

The *Stele* is the middlemost part of the *Flower*, sticking to the Rudiment of the *Fruit* or *Seed*. It is called in Latin *Stylus*, because of its being thin and long. All these parts are very distinguishable in a *Rose* and *Lilly*.

XV. *The Diversity of Flowers.*

Some *Flowers* want a Stele, as those that grow upon the *Bay Tree*; some instead thereof have a *Stalk*, as *Saffron*. All others generally have a *Stele*, as appears in the *Apple Tree* and in a *Rose*. But more particularly they differ in *colour*, which in a *Violet*, is Purple; in a *Marygold*, Yellow; in a *Blue-Bottle*, Blue; in a *Lilly*, White, and in a *Rose* various, there being *Red Roses*, *Damask Roses*, *White Roses* and party *colour'd*. Neither do *Flowers* less differ by their *smell*: And what is worth our consideration, we find a most grateful odor in a *Rose*, and none at all in the *Plant* whence it grows; whereas in *Sage*, the *Flower* is without any *smell*, tho' the *Herb* it self be very odorous: In *Borage* we perceive both *Plant* and *Flower* destitute of any *scent*; whereas in *Lavender* both the one and the other are odoriferous.

XVI. *The Fruit.*

The *Fruit* as it includes the Seed, and Flesh or Pulp of the Fruit, is the last work, and, as it were, the Masterpiece of the Plant; and to the producing whereof all the other parts of the Plant do concur. Its Fashion or Figure is various; some are partly of a *Conical* figure, as *Pears*; others of a solid Elliptick figure, as *Olives*, *Plums*, &c. some are *Round*, but somewhat flatted at both ends, as *Apples*; some perfectly *Round*, as *Cherries*, *Grapes*, *Berries*, *Correns*. They have also different Coverings; for *Wheat* is cover'd with a single *Membran*; a *Chesnut* with a *thick Skin* full of *Prickles*; an *Acron* with a *scaly Shell* or *Cup*; *Almonds* and *Wallnuts* inwardly with a hard *Shell*, and outwardly with a green *Shell* or covering.

XVII. *How Plants are said to bring forth their Fruits.*

Plants are said to *bring forth*, when they *bloom* or flourish, and when the *Flowers* break forth from the *Knops* or *Buds*; but the *Education* or *Rearing* of their *Off spring* is in the *Fruit*, for the sake whereof a *Plant* grows, and is therefore call'd the *Mother* and *Nurse* of her *Fruits*.

XVIII. *Whether Leaves, Fruits and Flowers be the true Parts of a Plant.*

It hath been a long controverted *Question* amongst the *Ancients*, whether *Leaves*, *Flowers*, and *Fruits*, were to be accounted parts of a *Plant*. THEOPHRASTUS seems inclin'd to the negative, as supposing them to be no more the parts of a *Plant* than the *Births* of *Animals* are any part of them; for they being after a certain term separated from their *Parents*, cannot after that properly be called *Parts* of them. But this Controversie seems only to be about *words*: for if *Leaves* may not be accounted as the *Parts* of those *Trees*, whence they are yearly separated at the Fall, as in the *Oak*, *Wallnut-tree*, &c. why may not they as well be denied to the *Pine*, *Olive Tree* and such others which never are without *Leaves*, seeing that those *Trees* also lose their *Leaves*, tho' not altogether, but by a continual succession of new ones, shooting out in the room of the old ones. Therefore those who account only that to be a part of a *Plant* which always continues with it, have good reason to bar *Leaves* of that Priviledge; for otherwise I see no reason, but they may well enough be admitted to be parts of a *Plant*.

CHAP. IX.

Of the Original of Plants.

I. *There is Virtue in the Earth, whereby it is impowered to bring forth Plants.*

IT cannot be questioned, but that in the *Beginning* of the *World* there was a Power communicated to the *Earth* of producing *Plants*, and that great variety of *Vegetables* that are found in all *Countries*. In the first Chapter of *Genesis* we find these words, *Let the Earth bring forth Grass, the Herb yielding Seed, and the Fruit-Tree yielding Fruit after its kind, whose Seed is in it self after his kind.* Now this *virtue* imparted to the *Earth* continues still in its full vigor, neither doth any thing spring out of the *Earth*, but by this *virtue*. But forasmuch as many *Vegetables* seem to spring of themselves, whereas others are manifestly beholden to *Root* or *Seed*, for their *Growth* or *Production*; we are to enquire how this twofold *Production* is performed, and how it comes to pass that some *spring* as of themselves, whereas others stand in need of a manifest *Seed* for their *Production*.

II. *What those Plants are that grow of themselves.*

Those *Plants* are said to *spring* of themselves, which the *Earth* produceth without the *sowing* of *Seed*, and to grow by accident, as the *Schools* express it. Such as are *Purslain*, *Housleek*, *Pennyroyal*, &c. which, as some tell us, do of themselves grow out of the *Earth* that is dug up, in a *shady* and *moist Wood*, being put into *Earthen Pots*. PORTA tells us, *lib. 2. Phyt. cap. 1.* that having exposed some *Earth* that had been dug up from the deepest *foundations* of a *House*, to the *Air*, within a few days, several kinds of *Herbs* sprung up from it, familiar to the *Soil* and *Climat* of of *Naples*. And the famous *Lord VERULAM* assures us, that the *Earth* dug up from the *foundations* of *Houses*, or from the bottom of *Wells*, being put into *Pots*, will after a set season produce several sorts of *Herbs*. For if you take up *Earth* not above an *Ell* deep, it will be fruitful the first year; but if you take up that which lies deeper, it will not produce any thing till after a years time, and sometimes 2 years.

III. *The Plants which are said to grow of themselves, owe their Rise to Seeds.*

Some *Philosophers* are of opinion, that such *Plants* as these are produced without any *Seeds* at all, and that the *Earth* produceth them by an innate *vertue* of their own. But that which hinders me from assenting to this *opinion* is, because I find that all *Countries* do not produce the same *Plants*; which could not so happen if there were not diverse dispositions in them, proper for their several *Productions*. But what can these different *Dispositions* be, but *Seeds*; or those first *Buds* from whence *Plants* arise? For what else doth the *Sun* do, when it cherisheth the *Earth* with its heat, mixeth it with Water, exhales the moisture from it, dries the *Particles* of it, *&c.* but work such dispositions in the *Earth*, and so fit the insensible parts of it, as that from the due ranging of them, the *Roots* of *Plants*, their *Strings*, *Ribs* and *Veins* are formed, through which their *Aliment* may be conveighed, and being sufficiently prepared, break forth in the other parts of it?

The

IV. *What are the Seeds of Plants, that are said to grow of themselves.*

The *Seeds* therefore of these *Plants*, are those *Insensible Particles*, which by the agitation of the *Subtil matter* do obtain such a *situation*, *figure*, and *motion*, as are needful to form the first Rudiment of a *Plant*. And forasmuch as this *dispostion* of *parts* is not to be found in all Parts of the *Earth* alike; therefore it is no wonder, that all *Plants* grow not in all *Countries*. We are to take Notice also, that there is no difference betwixt these kind of *Seeds*, and those which are the Product of *Plants*; save only this, that the Parts of these latter are more closely compacted together, and more orderly framed: Whereas those which arise from the various *Motion*, *Spreading*, *Mixture*, and *Composition* of concurring *Particles*, are not so exactly joyn'd and formed, and therefore *Plants* are more slowly produc'd by them.

V. *The first Trees were produc'd without Seed.*

Some *Authors* relate as Miracles, that sometimes tall *Trees*, yea, whole *Woods*, have sprung out of the *Earth*, without *Seeds*: But they did not consider, that vast store of *Seeds*, which are hid in the *Earth*, and are the beginnings and first Draughts of those *Seeds* that are the products of *Herbs* and *Trees*. THEOPHRASTUS observes, 3 *Histor.* 2. that the *Earth* in *Crete*, presently after it was dig'd up, did bring forth *Cypress* Trees, which are also propagated by *Slips*. Can any one believe, that the first *Trees* were the product of *Seeds* fallen from Trees? Or, that the Great *Woods* that are found up and down, were *sown* by *Men*? For seeing that the *World* had a Beginning, and that we cannot admit a progress to Infinite, we must come at last to those *Trees* which had no such *Seeds*, whence they were produc'd, and for the production whereof the Nature of the *Climat* and *Soil* were sufficient. For *Cinnamon*, *Myrrh*, *Frankinsence*, and *Cassia*, did always abound in *Southern Countries*; as the *Northern Grounds* never wanted *Willows*, *Oaks*, *Firr-trees*, *Elms*, *&c.* which delight most in those places, and will not without care and difficulty grow elsewhere. According to that of *Virgil*:

The blackest Ebony from India *comes,*
And from Sabæa *Aromatick Gums.*

VI. *Calcin'd Earth produceth great abundance of Plants.*

Some observe, that *Earth* that is *burnt* or *calcin'd*, when expos'd to the *Air* and *water'd* with plentiful *Showers*, doth immediately bring forth great store of *Vegetables*; because the *Pores* of the *Earth* being opened by this means, the *Seeds* are set free from their Prisons, and meeting together are entangled, and so constitute little *Masses*, from whence those *Plants* proceed. It is a thing very notorious, that in *Walks* that are thick overspread with *Sand*, the *Earth* the first Year produceth only *knotted Grass*, the following Years a *thick* and *swoln Grass*, like the blade of *Corn*; because the *hardness* of the *Sand* or *Gravel* hath hindred the due coagulation of the *Seeds*; but as the *surface* of the *Earth* comes to be more freed from the *Sand*, the *Seeds* can the better come together, and thus produce common *Grass*; to which *Showers* do very much contribute, by moistning the *Earth*, and thereby setting the *Seeds* that are in it more at liberty.

VII. *How Plants are produc'd from*

As to *Plants* that are *Sown by Men*, the Explication of their way of *Production* is not difficult. For when, by Example, a *Pea* or *Bean* is put into the *Earth*, and there meets with a due *moisture* and moderate *heat*, it first begins to swell, and distends its *Skin* or *Husk*, and having at last broke it, the same Causes continuing, do afford it new *Matter*, and the first beginning of the *Plant*, which we call the *Bud*, appears; which by thin *Fibres* or Strings, spreading it self through the *pores* of the *Earth*, and the Parts of it pressing upon it, must needs grow hard; and thus is the *Root* of the *Plant* formed. The Matter being thus digested into a *Root*, being recruited by new Incoms of *Heat*, and dilated by the same mounting upwards, the tender and green *Substance*, which is commonly call'd the *Leaf* or *Bud*, riseth and springs up; which still growing higher, turns to a *Stalk*: For a *purer Juice* being now duly prepared in the *Roots*, doth by degrees ascend from thence into the *Stalk*, which Motion upwards is much promoted by the *pores* of the *woody Stalk* or *Stem*. Moreover, *Heat* being active and impatient of *Idleness*, continually drives the *moisture* or *Juice* upwards; and so the *Stalk* becomes extended, and riseth to a considerable height. Now when the *Juice* doth not ascend so fast, and that the *parts* of it, by the agitation of *Heat* are more depurated, they are by the driving of the *Fire* carried above the *Stalk*, where meeting with the *cold Air*, they are stopt from mounting any higher; where still more *particles* of the said *Juice* joyning them, they swell into a *Bud*. And whereas the affluence of *Heat* through the Stalk still continues, is bursts open, or splits the *Bud*, and by this means makes way for the *Subtil matter* to break forth, and display it self in the appearance of a *beautiful Flower*. And lastly, after that the *Alimentary Juice* hath still attain'd a further degree of Perfection, another *Substance* succeeds in the room of the *Flower*, which being hollow within, contains the *Fruit*, that is, the *Pea* or *Bean*, and is a defence to it, against the Injuries of the *Air*. For in all *Natural things* there is, as it were a kind of *Circle*, whilst the *Seed* of the *Plant*, under a different respect, is called the *Antecedent Principle*; and the *Fruit* the *Consequent*.

perfect form'd Seeds.

CHAP. X.

Of the Nourishment, and Growth or Increase of Plants.

HAving spoken of the *Forming* of *Plants*, we now proceed to Treat of their *Nourishment*, which seems to be nothing else but a continued *Generation*; because all the Parts of that which is generated would fall away immediately and waste, without the supply of *food*, that preserves them from perishing.

I. *The Generation of Plants, is accompanied with their Nutrition or Nourishment.*

II. *What the Nutrition or Nourishment of Plants is.*

The *Nutrition of a Plant* therefore *is the distribution of the inwardly received, and altered Aliment, into all the Parts of it; and the transmutation of it into their Substance, for the supply of what continually wastes and evaporates by the force of Heat.* For the Moister parts of *Plants*, as well as *Animals*, are in a continual *flowing*, as is manifest from the *Leaves* and *Flowers* that are pluck'd off from them; for these immediately grow limber and wither, by the want of that *Juice*, which used to distend their *Vessels* and *Bladders*.

III. *Nutrition in Plants, is not an effect of Choice.*

Not that *Plants* make uſe of choice in attracting of their *Aliment*, ſo as to take in that which is agreeable to them, and reject the contrary; forasmuch as no ſuch *attraction* can be found in *Natural things:* But we muſt rather conclude, that the *pores* of the *Roots* are of ſuch a *figure*, as are fit to admit thoſe *particles* that are proper to nouriſh the *Plant*, and exclude the reſt; after the ſame manner as the *Liver*, by tranſmitting the *Gall*, and the *Kidneys* the *Urine*, do thereby ſeparate them from the *Blood*.

IV. *Heat is neceſſary to the Nutrition of Plants.*

This will be ſtill more manifeſt, if we ſuppoſe 2 things in *Plants*, *viz. Heat* and *Pores*, which are the *Inſtruments* of *Nutrition*: For by *Heat* the *Alimentary Juice* is driven upwards, not only from the *Earth* into the *Root*, but alſo into the *Trunk*, *Branches*, and the utmoſt *Leaves*: And in this its paſſage the *Nouriſhment* is further concocted, prepared, diſtributed and coagulated, ſo as to be fit for the *Aliment* of *Plants*. For in every *Plant* or *Vegetable* there is ſomething, which with reſpect to the *Earth* whence they grow, has the Nature of a *ferment*.

V. *Whence this Heat proceeds.*

If you demand, whence this *Heat* proceeds; and what that Agent is which begets a *fire* in *Plants*? I anſwer, That the *primary Cauſe* of this *Heat* is the *Sun*, whoſe *Rays* in the *Summer* time do continually beat upon the *Earth*, and the *Plants* that grow out of it: Neither is the *Earth* in the *Night*, or during the *Winter*, altogether deſtitute of *Heat*, but preſerves always ſome portion of warmth communicated to her by the *Sun*, whereby ſhe foſters the *Plants* in her *Bowels*, and aſſiſts their *Nutrition*. Tho' it cannot be deny'd, but that ſometimes this *heat* in *Plants* is owing to *Subterraneous*, or any other *fires*: As we find that *Aloes*, *Onions*, *the Roots of Saffron* and *Leeks* will grow, being hung up in Rooms, eſpecially where conſtant *fires* are kept.

VI. *Pores alſo are neceſſary to the Nutrition of Vegetables.*

Pores likewiſe are of great uſe to the *Nutrition* and *Increaſe* of *Plants*, ſince they are the *paſſages* by which the *Juice* is received, and through which it is diſtributed to all the Parts of the *Plant*. For as the *Lacteal Veins*, and the *Subclavial Branches* of the *Vena Cava*, are neceſſary for the receiving of the *Aliment*, and the conveying of it from one part of the *Body* to another; ſo likewiſe there are found in *Plants* innumerable *Paſſages* and *Channels*; like to the *Lacteal Veins* in *Animals*, by which the *Juice* is tranſmitted from the *Root*, to the utmoſt parts. For ſuch is the diſpoſition of *Pores* in *Vegetables*, that the *Aliment* is much more conveniently tranſmitted by them, than it could be through the free and open *Air*; for by this means the diſſipation of the *Alimental Juice* is prevented, and its *motion* is more ready and without interruption: As we find that *Bullets* move more readily through *Pipes*, and *Smoak* through the *Funnel* of a *Chimney*, than in the open *Air*. And hence it proceeds, that *Lands* that have been often *ſown*, are thereby more exhauſted, than thoſe that lye Fallow.

VII. *How Plants are nouriſhed.*

Theſe things being underſtood, it will be no longer difficult to conceive, how the *Nutrition* of *Plants* is performed, and how they are increaſed; for *Vegetables* are nouriſhed whilſt the *Juice* is by the *Sun*, and the reſt of the *Subtil matter*, driven into the *pores* of the *Root*, and being there prepared by Concoction, after it hath paſt ſeveral ſtrainings, doth ſpread it ſelf in *length*, *breadth*, and *depth*. The ſoftneſs alſo or tenderneſs of the *Sprout* or *Sprig*, doth much further the conveyance of the *Nouriſhment*; becauſe it makes the *Pores* to be eaſily widened and diſtended. For as we find that the *pores* of *Bread*, being dipt in *Wine* or *Water*, become immediately diſtended thereby; ſo likewiſe the *Alimentary Juice*, when driven into the little Channels of *Vegetables*, doth open and extend them: Which doth not happen ſo in a dead or wither'd *Plant*; becauſe in it the parts of the *Pores*, and ſmall *threads* or *fibres*, are otherwiſe diſpoſed, ſo as not to be able to admit the *Juice*, which the *Subtil matter* hath driven into the *Roots*.

VIII. *The Nouriſhment of Plants conſiſts of a Moiſture, mingled with the Fatneſs of the Earth.*

The *Aliment* of *Plants* muſt be *Liquid*, becauſe it would not be fit to be carried upwards, or ſtrained, in caſe it were dry or hard. Yet is not this *Juice* a *moiſture* deſtitute of all Clammy-fatneſs of the *Earth:* For ſeeing that the parts of a *Plant* muſt ſtick and grow together, and that this cannot be without the entanglement of *Heterogeneous particles*; it is evident, that *Water* alone cannot be a fit *Aliment* for *Plants*, except it be well temper'd, with a ſufficient proportion of the Slimy-fatneſs of the *Earth*. And accordingly we find, that *Waters* in which *Salt* is diſſolved, or mingled with ſome Fat matter, are moſt proper for this *effect*, and make the *Vegetables* that are *watred* therewith, to thrive mainly. And it is for the ſame Reaſon, that *Countrymen* do recruit their barren Grounds with *Dung*, *Marle*, and the like. For *Water* alone too ſwiftly penetrates the Parts of *Vegetables*, nor ſtays long enough with them, ſo as to become their *Aliment*.

IX. *Different Plants require different Nouriſhment.*

Tho' the *Aliment* of all *Plants* be Moiſture, temper'd with the Fatneſs of the *Earth*; yet is not every ſuch *mixture* fit Nouriſhment for every *Plant*. For as *Vegetables* affect particular places; ſome delighting in *ſhady* and low *Valleys*, others in *high* and *upland Grounds*; ſome in *dry* and *ſandy*, and others in *moiſt Ground*; ſome in a *fat* and *rich Soil*, and others in a *barren* and *hungry:* So accordingly do they ſtand in need of a different *Nouriſhment*, which when ever they miſs of, they ſoon languiſh. For the *Particles* of theſe *Juices* being various, they muſt needs conſtitute different *Liquors*, whereof thoſe only are a fit *Nouriſhment* for ſuch and ſuch a *Plant*, which have an affinity with it, by the ſuitableneſs of the configuration of their Parts. Thus it is obſerved, that thoſe *Roſes* ſmell ſweeter, that have *Garlick* growing near them; becauſe the *particles* proper to produce a ſtrong and ungrateful *Scent*, are taken in by the *Garlick:* So that few or none of them can come to the *Roſe*, to allay or diminiſh the ſweetneſs of its *Odour*.

X. *The Stocks and Branches of Trees grow every year.*

The *ſtocks* or *ſtems* of *Trees* and *Shrubs*, with the *Branches* proceeding from them, are every *year* increaſed by new *woody* acceſſions; forasmuch as every *year*, a new round of *Fibres* is added to the inward *Bark* or *Rind*; which being divided in two parts, the outward part of it is added to the *Bark*, and the Inward part growing harder and harder, before the end of *Autumn*, acquires the compactneſs of *wood*, and ſeparating it ſelf from the *Bark*, becomes joyned to the *Wood*, and ſo increaſeth the *Trunk* or *Stock* of the *Tree*. But tho' we find, that the *Trunks* and *Branches* of *Trees*

are

are encreaſed this way only, yet muſt we not conclude from hence, as is commonly believed, that the *Juice* or *Sap* of a *Tree*, mounts upwards only betwixt the *Bark* and the *Wood*, but alſo through thoſe *Veſſels* that lie hid in the *Subſtance* of the *Wood*. This is evident in that the deeper any hole is bored into the *Trunk*, the *Branch* or *Root* of the *Tree*, the more *Juice* will diſtill from it, and that proportionably to the depth of the hole; ſo that out of a *hole* that is twice as deep as another, almoſt a double quantity of *Sap* will proceed in the ſame time.

XI. *This illuſtrated by the Example of a young Cheſtnut-tree.* This may be eaſily underſtood by the *Example* of a young *Cheſtnut-tree*; for if the Progreſs of its growth be narrowly obſerved, we ſhall find, that after 6 *months* time, there will be formed in its *Bark* (which is very thick) 2 rows of *woody Fibres*; and after 18 *months*, we ſhall find 4 of them; and a year after 8, and ſo on, ſo that always the laſt *Rows* do incloſe and involve the former, and make, as it were, a Circle about them, which is ſurrounded with another *Circle*, and that again with another; whence it follows, that when the *Stem* of any *Plant* is cut acroſs, the Section muſt appear compoſed of 2 ſorts of *ſubſtances*, *viz.* of theſe *Circles*, and of *inſertions* that are diſpoſed or ranged in the ſaid *Stock*, much like *Circles* of *Longitude* and *Latitude* in a *Terreſtrial Globe*.

XII. *How Pants grow and encreaſe.* *PLANTS* therefore grow or encreaſe, when greater or more *Particles* of *Alimentary Juice* are received by them, than their narrow *Pores* are able to contain. Hence it is that thoſe *Vegetables*, the ſides of whoſe *Pores* are more hard and compact, do not grow ſo faſt as others, whoſe texture is more looſe and open. Thus we find that *Peach-trees*, *Poplars* and *Willows* grow apace, becauſe they have pliable *pores*, and ſo crooked and bending, that the *Particles* of *Juice* that are driven upwards by the agitation of the *ſubtil matter*, can neither advance forward, nor return, and conſequently they muſt enlarge and diſtend the *Plant*. And for this reaſon it is that a *Vine*, frequently *watered*, thrives and advances ſo faſt; and that the *Chryſanthemum* or *Marygold* of *Peru* in 6 *months* time grows 18 or 20 foot high; and by the thickneſs of its *Branches* ſeems to challenge the talleſt *Trees*. But on the contrary, *Oaks*, *Medlars*, *Box*, and *Pine-trees* grow very ſlowly, becauſe the compactneſs of their *ſubſtance*, will not ſuffer their *pores* to admit ſufficient ſtore of *Aliment* for their ſpeedy growth and encreaſe. Thus *Golden Maiden-Hair*, *Whitlow-Graſs*, &c. grow very ſlow: and for the ſame reaſon *Trees* advance little or nothing in their growth during the *Winter Seaſon*, becauſe their *pores* being then ſhut up by *cold*, the agitation of *heat* is not of ſtrength enough to widen them, and to ſend up the *Juice* from the *Root* through them.

XIII. *How the Juice comes to be joined to the Plants, and ſtay with them in order to their encreaſe.* It may be queſtioned here, how the *Alimentary Juice*, which is forceably driven into the *Pores* of a *Plant*, comes to ſtay there, without being carried upwards into the *Air*, or without falling down to the *Root* again.

XIV. *Anſwer.* To which I Anſwer, that this effect may be aſſign'd to 2 *Cauſes*: the *Firſt* is a ſpecial conformation of the *Pores* of *Plants*; for we may ſuppoſe that by the continual aſcent and percolation of the *Alimental Juice* through the *pores* of the *Plant*, many of their ſmall *Fibres* muſt be bent in ſuch a manner, as to make the paſſage rough, by which means, tho' the liquid and fat *moiſture* eaſily mounts up through them, yet cannot ſo eaſily run back again, becauſe of the prominent extremities of the *Branchy particles*, which oppoſe their return the ſame way they entred. Daily experience confirms this, for we find that when with a *Knife* we cut or ſcrape a piece of *wood* with the *grain*, that is following the natural poſition of its *fibres*, we do it with much more eaſe, than when we attempt the ſame the contrary way. The *other* cauſe is the *Winter Froſts*, and the *coldneſs* of the *night*, which do fix and condenſe the *Juice* conveighed to all the *parts* of the *Plant*, and by obſtructing the *Pores*, hinder it from ſubliming into the *Air*. For it is certain, that in the *Nutrition* of *Plants*, *Heat* and *Cold* both act their parts, the one being not ſufficient to perform it without the other.

XV. *The Alimental Juice in Plants is circularly moved.* It is to be obſerved, that as the *Blood* in *Animals*, ſo likewiſe the *nouriſhing juice* in *Plants* is prepared by a kind of *Circulation*. For the *Juice* that is in their *Roots* or other *parts*, being toſt by a continual *motion*, cannot throughly be diſſolved, mingled or ſtrained, without frequently returning to the ſame part again, and being altered by various impreſſions. Which *Circulation* of the *Alimental Juice*, depends on the *Mechanical Structure* of the *Fibres*, the various diſpoſition whereof performs the ſame effect, which the *Valvulæ* do in the *Veins* of *Animals*; ſome of them being ſo formed, that the *Juice* finds a ready way to mount up between them; and others, ſo as to afford it an open and free Deſcent. Which may be proved by ſeveral *Reaſons* and *Experiments* in thoſe *Vegetables*, which are nouriſhed by a thick *Juice* reſembling *Milk*.

XVI. *The Proof of this Circulation in Plants, from thoſe of them that have a Milky Juice.* Mr. *MARIOTTE* aſſures us that he hath obſerved, that upon the cutting off the *Tops* of *Milky Plants*, and the parts nearer the *Leaves*, a greater quantity of *Juice* hath proceeded from them, than by cutting the parts nearer to the *Root*. That he experienced this in *Celandine*; and the ſtructure of *Fibres* in *Spurge*, and other *Milky Plants* perſuades the ſame; for theſe *Fibres* by the help of a *Microſcope* appear *white*, and are nearer unto the *Rind*, whereas the *Juice* in the other *Fibres* is of a more *Watry Colour*. Whence it ſeems probable, that the ſerous *Juice*, doth mingle with the other thicker, whether *Yellow* or *White*, in certain *Pipes* appointed for that uſe, much after the ſame manner as the *Chyle* entring into the *Veins* is there mixt with the *Blood*, and *circulates* with it. Tho' it be not yet diſcovered whether this *Juice* in *Plants* be carried in the ſame *Pipes* from the *Branches* to the *Roots*, and again from the *Roots* to the *Branches*; or whether diſtinct *Pipes* are aſſigned to theſe different *motions*, as the *Veins* and *Arteries* in *Animals*.

CHAP. XI.

Of the Diviſion and Difference of Plants.

I. *The Diviſion of Plants.* A Perfect *Plant* is by *BOTANISTS* commonly divided into a *Tree*, a *Shrub*, an *Underſhrub*, and an *Herb*.

A Tree

II. *A Tree.* *A* Tree *is a woody Plant, in thickneß and height exceeding all the reſt, whoſe ſtock is laſting, and one only by nature, which ſpreads it ſelf into many Branches and Boughs,* as an *Oak*, *Pear* and *Fir-tree*. I ſay it is *laſting* or perpetual, becauſe it hath no certain time of duration.

III. *A Shrub.* *A* Shrub *is a Plant of a mean thickneß and height amongſt thoſe that are woody, whoſe Stem is manifold by nature, and which by cutting off its Shoots or Suckers, is eaſily changed into the nature of a Tree.*

IV. *An Under-ſhrub.* *An* Under-ſhrub *is the leaſt of woody Plants in height and thickneſs, having a laſting Stem or Stalk, which ſometimes is ſingle, and ſometimes manifold like Bruſhwood, with a ſmall and ſlender Leaf,* as *Roſemary, Lavender, Southernwood,* &c.

V. *An Herb.* *An* Herb *is a Plant which conſiſts only of Leaves,* as *Harts-tongue,* &c. *or ſometimes of a Stalk, but periſheth away every year, and is not woody till after it be dried.*

VI. *The Diverſity of Plants may be deduced from ſeveral Heads.* The variety of *Plants* is aſſignable either to the *Soil* whence they grow; or to the *Pores* or channels through which their *Alimentary Juice* is conveighed; or to their *Structure* or *Figure*; or to the *Fruits* they bear; or to their differing *Qualities*, or laſtly to the *Changes* and *Alterations* to which they are obnoxious.

VII. *From the Place of their Growth.* With regard to the *place* of their *growth*, ſome are upon *Rocks, Walls*, the *Tops of Houſes*, when the *water* falling in abundance, doth leave ſome limoſity upon thoſe *places*. Some grow upon other *Plants*, or upon *great Stones*; as *Moſs* which grows upon the *Barks* of *Trees*; and *Touchwood* which ſticks to the *Oaks* and *Nut-trees*. Some proceed from the rotten *Wood* or *Roots* of *Trees*, as *SCALIGER* tells us, that *Bearsfoot* doth, *Exercitat.* 140. Others grow upon *Dunghills*, as *Sow-thiſtle*, which *Hogs* delight in, and other ſuch like. Some grow upon the *Bodies* of *Living Creatures*, as is related of a *Shepherd*, who had a little *Plum-tree* or *Sloe-buſh* growing out of his *Breaſt*, becauſe falling by chance upon one of them, he had forgot to pluck out one of the *thorns* of it which ſtuck in his *Breaſt*, and afterwards ſprouted out thence.

VIII. *From their different Pores.* *Plants* are alſo diſtinguiſht by their *Pores*; for the *Alimentary Juice*, according to the different ſtructure of the *pores* it paſſeth through, acquires a different *Temperature* and *Qualities*. According to which different diſpoſition of the *Pores*, ſome *Plants* are more early in their coming forth, and others later. For thoſe that want a *Stalk*, or have only a ſhort one, are more ſlowly nouriſhed: others that have a more favourable *Texture* of their *Pores*, and the *Fibres* of whoſe *Stems* are more yielding, grow ſooner, and to a greater *Size* and *Bulk*, eſpecially if the *Climate* and *Soil* agree with it. Thus *Gourds* and *Sallows* do in a little time encreaſe to a great *Bulk*; whereas on the contrary *Oaks* and *Pine-trees*, by reaſon of the ſtraitneſs of their *Pores*, are as ſlow in their advance. And therefore becauſe the *Fir-tree*, and others of that nature conſiſt of looſer and more open *Pores* than the *Ebone-tree*, and other-like hard and compact *woods* brought from *Brazile*, they are eaſily bent, but not without difficulty pulled aſunder: whereas the parts of theſe latter are very Brittle and break upon the leaſt bending, becauſe of the very cloſe and compact texture of their *Parts*. It is alſo from this various diſpoſition of the *Pores*, that the ſame Rain furniſheth nouriſhment to ſuch a vaſt number of different *Plants*, becauſe it is changed according to the difference of the *Soil*, and the variety of the *Pores* doth diverſly affect the ſaid *moiſture* and alter it, ſo as to become the proper nouriſhment of ſuch and ſuch a *Plant*. To which may be added, that the *Juice* which is drawn from one part of the *Earth*, doth furniſh it with other *Alimentary Particles*, than another doth.

IX. *How the Juice of the Earth aſcends in Plants.* But if any one ask, how the *Juice* aſcends from the *Root*, into the *wooden Fibres*; they may take this for an Anſwer, that the *Juice* aſcends in *Plants*, after the ſame manner as *water* mounts up into thoſe *Pipes* that are made uſe of in the *Experiments* of a *Vacuum*; that is to ſay, becauſe the weight of the *Air* drives them upwards. Which effect of the *Air* is much encreaſed by the *Circular Motion* of the *Earth*, for it being the Property of that *Motion*, to drive all the moſt agitated parts far from the *Center*; accordingly it alſo drives all the *Juices* of the *Earth* into the *Pores* of the *Plants* that are more agitated than the *Air*; whether this their *agitation* proceed from *Subterranean Fires*, or from ſome particular fermentation in the out parts of the *Earth*.

X. *From their Figure.* A great variety likewiſe ariſeth among *Plants* from their *Structure* or *Figure*; for ſome are low, as *Onions* and other creeping *Plants*. Others grow to a vaſt Height, as *Cedars* whoſe height and thickneſs is wonderful; *Hiſtorians* mention one that grew in *Cyprus* to have been 130 foot high, and of that thickneſs that 3 men could ſcarcely fathom it. And ſo likewiſe the *Fir-tree*, *Abies*, which takes it *latin* name from *Abire*, that is, to go away, becauſe of the vaſt height it oft riſeth to. *Hiſtorians* tell us, that in the *Ship*, that by command of the *Emperour CAJUS* brought the *Obeliſk*, placed in the *Vatican Circus* or *Piazza*, from *Egypt*, there was a *Fir-tree*, whoſe Trunk was as much as 4 men with their ſtretched-out-arms could compaſs. Some grow of a round *Figure*, as *Puffs*, others in the form of an *Umbrella*, as *Muſhromes*. Some have the ſtrings of their *Barks* extended long-wiſe, others a-thwart and Croſſ-wiſe. Some naturally have crooked *Stems* or *Trunks*, as the *Vine*, others ſtrait and upright, as *Reeds* and moſt *Trees*.

XI. *From their Fruits.* *Plants* are alſo differenced according to their ſeveral *Fruits*: and thus ſome are called *Glandiferous* or *Acorn-bearers*, as the *Beech*, the *Oak*, the *Cork-tree* and the *Cheſtnut-tree*, which latter, for thee goodneſs of its *Fruit*, excells the reſt of the *Trees* of this ſort. Others are *Coniferous*, bearing a *Fruit* like a Cone, that is ſmaller at one end and like a Top; ſuch as is the *Cedar-tree*, which formerly grew in great abundance upon *Mount Libanus*, but are reduced to 24 only. So alſo the *Cypreſs-tree*, and the *Firr*, tho' this is reckoned amongſt the *Reſiniferous* or *Roſin* yielding *Trees*. Others are *Pomiferous*, or *Apple-bearers*, as the *Apple-tree*, the *Citron-tree*, which is always green, of a moſt fragrant *odor*, and its fruit of a *golden Colour*; the *Orange* and *Lemon-tree*, the *Pomegranate-tree*, ſo called from the great number of *grains* of *Seed* which its *Fruit* doth contain; and the *Apricot-tree*, whoſe *fruit*, from the *golden colour*, were by the Greeks called *Chryſomela* or *Golden Apples*.

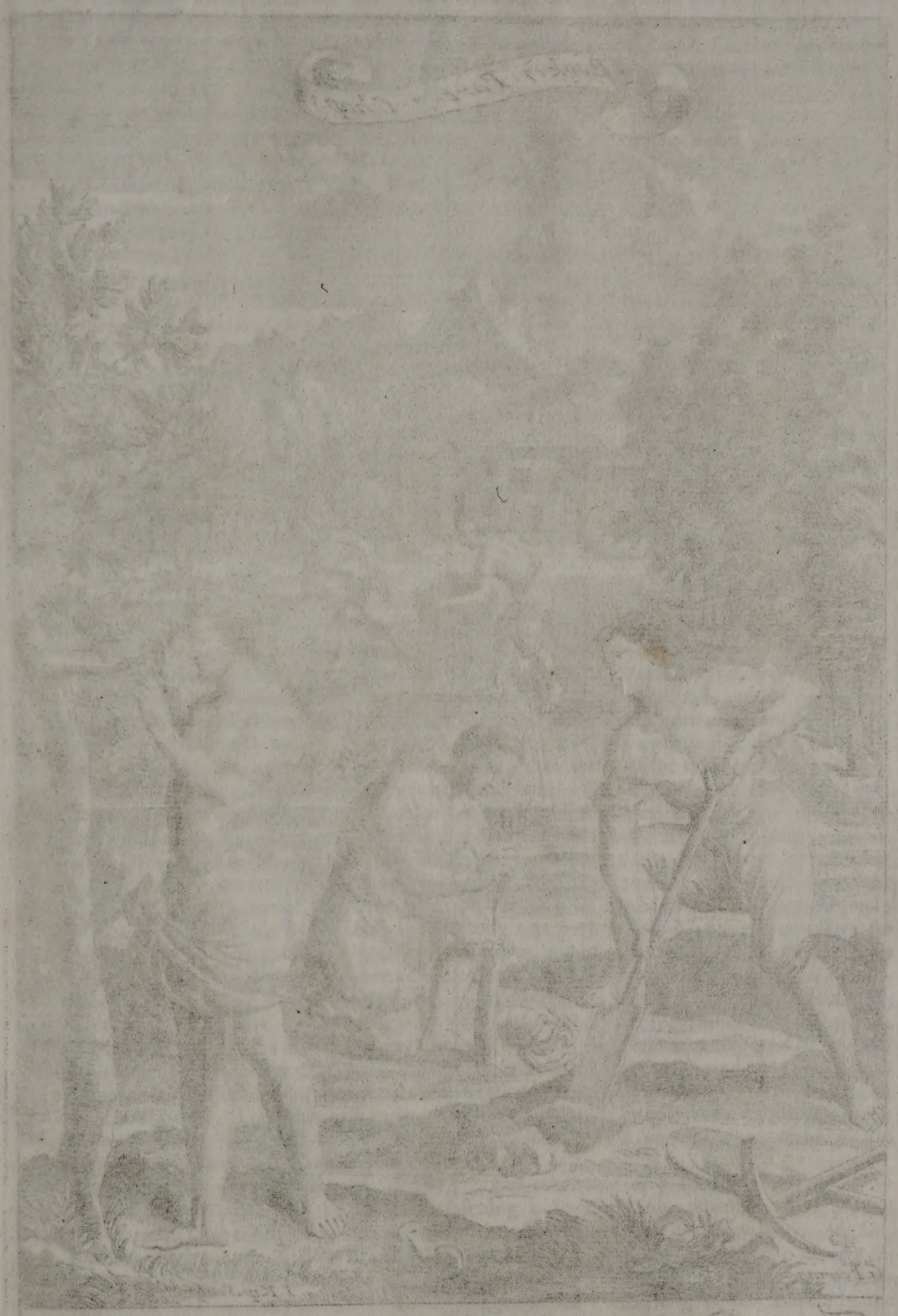
Of

VII.

IX.
How the
Juice of
the Earth
ascends in
Plants.

X.
From their
Figure.

XI.
From their
Fruit.



To the Right Worshipfull S.r
Denis Hampson of Taplow in
Buckingham Shire & of Bradwell in
Oxford Shire Baronet
This Plate is humble Dedicated by Richard Blome

XII. *Of Nut-bearing, Berry-bearing, or Cod-bearing.*

Of *Fruit-bearing Trees*, some are *Nuciferous* or *Nut-bearers*; as the *Nut-tree* and *Almond-tree*, which have their *Fruit* contained in hard *Shells*; others *Baccíferous* or *Berry-bearers*; as the *Plum-tree*, the *Olive-tree*, the *Mulberry-tree*, and the *Cherry-tree*, which bear a *Fruit* that consists of a more soft and moist *flesh*, and cover'd only with a thin *Skin*: Other *Siliquiferous* or *Pod-bearers*; as *Cassia*, *Tamarinds*, *&c.* because their *Fruit* is contained in *Cods* or *Husks*, or in a *Juicy shell*, of a longish *figure*.

XIII. *From their various Propensions or Inclinations.*

There is also a considerable variety in *Plants*, from their different *Inclinations*: For some of them have an Antipathy against others. Thus the *Vine*, and *Cabbage* or *Coleworts*, cannot endure the Neighbourhood of one another; and so likewise the *Olive-tree* and the *Oak*, the *Bay-tree* and the *Vine*, the *Olive-tree* and *Coleworts*, the *Nut-tree* and the *Oak* are at variance. Not by reason of any inborn *Antipathy*, as some do imagine; but because when those *Plants* stand near together, they rob one another of sufficient *Aliment*, because they are nourished with one and the same kind of *Juice*; which being taken in by the stronger and more vigorous *Plant*, the other must needs languish. And on the contrary, those *Plants* are said to be friendly to each other, which are nourished by different *Juices*; so that what is necessary for the *Aliment* of the one, is never touched by the other. And herein doth the *Antipathy* and *Sympathy* of Plants properly consist; according to what we have more largely explained in our *History of Nature, concerning Plants*. Thus the *Fig-tree* and *Rue* thrive in the Neighbourhood of each other, because they delight in a quite different sort of *Nourishment*; and not by reason of any Consent or Friendship, but by substraction of the contrary *Aliment*, which the one draws to feed its *sweet-scent*, and the other to feed its *bitterness*. And on the contrary, *Rosemary* loseth part of its *sweetness* and *savour*, when it grows in the Neighbourhood of the *Bay-tree* or *Lavender*; because both these *Plants* delight in the same *Alimental Juice*, and are like Robbers one to another, whenever they stand close together.

XIV. *From Artificial Transmutation.*

A Diversity is likewise to be found in *Plants* that springeth from *Transmutation*; as when *Plants* are made more fair and beautiful, by the Art and Industry of *Gardiners*. Thus that vast variety of *Gilly-flowers*, proceeds from this Cause. And in like manner there is now the *Calathiana*, a kind of *Violets*, not only of *Blew colour*, but also *White*, *Red*, and of a mixed *Colour*, by the Curiosity of Ingenious *Florists*. For the Industry of *Gardiners* doth conduce much to the variety of *Plants*; according to what *Virgil* tells us in his *First Book* of *Georgicks*:

I have seen many would Anoint their Grain,
With Nitre first, then Lees of Oil would spread,
That the Husk swelling might enlarge their Seed;
Then with lent Fire ripen the tender Grain.

XV. *From the Negligence and Carelessness of Gardiners, &c.*

And on the contrary, by the Negligence of *Gardiners*, or some fault in the *Soil*, Plants *degenerate*, and are turned into others not so good as themselves: So *Wheat* turns to *Darnel*, *Basil* into *wild Thyme*, *Barley* into *Oats*, *Turneps* into *Rhadish*, as SENNERTUS assures us; *Water-mint* into *Spear-mint*; the *Blak-Vine* into *Briony*, *Spelt* into *Wheat*, and *Wheat* into *Spelt*. It is also a common Observation, that if the same *Seed* be for several years together *sown* in the same Ground, it will degenerate; according to that also of *VIRGIL*:

When oft the fairest Barly i'th' same Ground we sow,
Darnel instead thereof, and blasted Oats do grow.

The same happens almost to all *Plants*, when they are transpos'd to different and disagreeing Places: As when *Herbs* that grow in *Pools* and *Running-water*, are removed to the Tops of *Hills*, or *Champion-ground*. Thus if the *Water-flag* should be transplanted to *Hilly-ground*; or the *Seed* of *Lettice*, *Cucumber* and *Cabbage*, to a *Sandy place*: And on the contrary, *Heath*, *Fern* and the *Thorn-bush*, to *moist* and *Marshy-ground*; they would soon degenerate to other *Plants*, and cease to answer to their *Names*.

CHAP. XII.

Of the Propagation of Plants.

I. *Plants are propagated by Sowing, Setting, and Grafting.*

PLANTS may be propagated or multiplied several ways; as either by *Seed*, or by a *Sprig* cut, or pluck'd off from the *Stock* and set into the *Ground*; or by *Graffing*.

II. *The Soil is to be prepar'd for the Reception Seed.*

But before that the *Seeds* of *Plants* are committed to the *Earth*, the *Soil* must be duly prepared; that is, it must be turn'd up by the *Plough*, or dug with a *Spade*, or cut with a *Weeding-Hook*, or broke with a *Pick-ax*, and the *Clods* broke with a *Harrow* or *Rake*. All which pains is taken, partly to root out the *Weeds* and unprofitable *Herbs*; and partly to make the Ground more light and loose, that the *Seeds* or *Slips* may the more easily take *root* in it, and spread their *fibres* far and near, and by this means attract a more copious *Aliment*.

III. *The fittest time for Sowing.*

Nature directs us to the most proper *Seed* time, *viz.* when the *Seeds* have attained their full growth and maturity; or, when by the opening of their *Husks* they fall to the *Ground*; or by the contraction or shrinking of them are thrust out; or by the *Down* that grows about them, they are by the Wind scatter'd up and down through the *Air*.

IV. *Of Propagating Plants by Slips or Sprigs.*

The other way of propagating *Plants*, is by setting a *Sprig* or *Slip*, whether cut or pluck'd quite off, or whilst it sticks yet to its *Mother*, thrust down into and cover'd with the *Earth*, till it hath taken root. These *Sprigs* or *Slips* may be bigger or less, according to the Nature of the *Plant*. For some are set from a greater *Branch*, others from a *Slip*, others from a *Twig*, and others from a *Shoot*.

V. *What kind of Twigs or Sprigs are to be Set.*

The *Twigs*, *Sprigs* or *Slips* that we would set, must be fresh and green: Yet *VIRGIL* tells us, that the *dry Sprigs* of an *Olive*, if set, will grow notwithstanding:

An Olive Branch, tho' dry, will shoot,
If set i'th' Earth, and spread its diving Root.

It is alſo obſervable, that the more tender any *Plants* are, the later muſt their *Sprigs* or *Slips* be ſet, that is, about the middle or latter end of the *Spring*, in theſe *colder Climats:* And if the *Weather* permits, they muſt be *watered* as ſoon as ſet; I ſay, if the Weather permits; for in *cold Weather*, too much *Moiſture* is apt to ſpoil them. And ſo alſo, if it be a clear Sky, and the *Sun* ſhine hot upon theſe new ſet *Twigs* or *Slips*, they muſt be ſhaded, leſt the *heat* of the *Sun-beams* ſhould ſcorch and dry them up.

VI. *What Graffing is, and how it is performed.* In the Second place, *Plants* are propagated by *Graffing:* Now *Graffing*, being taken in the largeſt Senſe, *is ſuch an application of a Graff or Bud to its own Stock or Branch, or to that of another Tree, whereby they become united and grow together.* Now foraſmuch as the moſt part of the *Sap*, aſcends between the *Inner Bark* and the *Wood*, the whole Art of *Graffing* conſiſts in this, that the *Inner Bark* and *Wood* of the *Stock* and *Graff* do anſwer exactly one to another; or that the *Scion* or *Bud* be ſo applied to the *Stock* or *Branch*, that the inner and outward *Bark* both of the *Stock* and *Scion* may ſo exactly anſwer, and make one continued *Body*, and one Even *Surface*, that the *Juice* may readily and freely flow from the *Stock*, to the *Graff* or *Bud*.

VII. *What Graffing is, and to what end it is done.* The End of *Graffing*, is to meliorate the Nature of *Plants*, by changing them into others. For ſince there is a twofold *Concoction* of *Food*, the one in the *Stock*, and the other in the *Graff*; it cannot be otherwiſe, but that the *Alimental Juice*, by theſe different Strainings, muſt be the better prepared, and partake of new *Qualities:* And therefore we find, that *Plants* by *Graffing*, do not only bring forth larger, but alſo better *Fruit*, than the *Tree* doth from whence the *Graff* is taken: And it is found by Experience, that the *Tree* which grows from the *fruit* of a *Graffed-tree*, or the *Sprig* thereof ſet in the *Ground*, doth bring forth leſs and meaner *fruit*, than doth the *Graff* it ſelf, from whence it was taken. Hence it is alſo, that we ſee one and the ſame *Tree* laden with diverſe *Fruits*; yea, and the ſame *Fruit* having a different *taſte*, *ſmell* and *colour*, in one part of it, from that it hath in the other, as alſo late Ripe *Fruits* to become early Ripe, and ſuch as are *Green* to become *Red*.

VIII. *There be three ways of Graffing: The Firſt is Infoliation.* There be three ways of *Graffing:* The firſt is within the *Inner Bark*, when the *Graff* is put in between the *Wood* and the *Bark*, and is ty'd faſt with a *Thread* or ſmall *Cord*. This way of *Graffing* is moſt proper for *Trees* that have a thick *Bark*, and abound with *Sap:* Becauſe the *Bark* draws abundance of fat *moiſture* out of the *Earth*; ſuch as are the *Fig-tree*, *Cherry-tree* and *Olive-tree*. Wherefore, he that would *graff* after this manner, muſt have a little *wedge*, made of ſome very hard *Wood*, and drive it in between the *Bark* and the *Wood* gently, ſo as not to rend the *Bark*, and in that aperture muſt *graff* his *Scion*. This way of *Graffing* was by the *Ancients* called *Infoliation*, and is ſtill in uſe with us, where the *Bark* is thick, and a ſmall *cleft* to *graff* in cannot ſo well be made.

IX. *The ſecond way of Graffing is in a* The *ſecond* way of *Graffing* is, by means of a *Cleft* made in the *Stock*, into which the *Scion* is put, ſo as that the *pith* of the one may be joyned with the *pith* of the other; and then the *ſlit* muſt be ſtopt up with *Clay*, and bound up with the *Bark* and *Moſs*. This way of *Graffing* is made uſe of in thoſe *Trees* that have a thin *Bark*, and are of a drier Complexion, their *Moiſture* living not much in the *Bark*, but within the *Pith*; ſuch as are the *Citron-tree* and *Vine*. And this way is properly call'd *Graffing*, which muſt be quickly done, leſt the *Scion* which is to be *graffed*, ſhould by delay become over dry.

X. *The third way of Gaffing is called, Inoculation.* The *third* way of *Graffing* is done by *Inoculation*, wherein the *Bark* of the *Scion* that is to be *Inoculated*, is ſo joyned to that of the *Stock*, whence the like quantity of the *Bark* is taken, that the *Buds* and *Eyes* of the one, may exactly anſwer to the *Buds* and *Eyes* of the other. For there is a certain *fat clammy Moiſture* between the *Rind* and the *Stock*, by which the *ſtrings* of the *Scion* are glewed and joyned to the *ſtrings* or *fibres* of the *Trunk* or *Stock*.

XI. *All other ways of Graffing are reducible to theſe three.* There be other ways of *Graffing*; as that which is done by *Emplaſtration* or *Plaiſtering*, whereby ſome part of the *Bark* of a *Scion*, with its *Buds*, is put into the *ſlit* of the *Bark* of a *Stock*, and the *Bark* of the *Stock* ſo cloſed again upon it, as that no mark of the *ſlit* remains; and afterwards is plaiſter'd and bound up. Another way is by *Boring*, when the *Graft* is put into the Hole that is bor'd into the *Stock*. There is alſo another way, which the *French* call *En perche*, when many little *Sprigs* with their *Buds* are graffed into a *perforated Perch*. But all theſe, and other ſuch like, are reducible to the 3 ways already mention'd: Foraſmuch as all of them agree in this, that the *ſtrings* of the *Sprig* or *Bud*, muſt agree and anſwer to the *ſtrings* of the *Stock* whereinto they are graffed; and that by this mixture or coaleſcence, the *wound* may be cover'd or grow together, leaving the *Bark* ſomewhat rough in that place. They agree alſo in producing the ſame effect, that is, the *melioration* of *Plants*, by reaſon of their Coction, both in the *Stock* and in the *Graff*, where the *Alimentary Juice* is further prepar'd and purified.

XII. *The Nature of the Graff becomes changed in proceſs of time.* By this *Art* of *Graffing*, not only *Trees* of the ſame Nature are mingled, as it were, and united; as *Apple-trees* with *Apple-trees*, *Pear-trees* with *Pear-trees*, *&c.* but alſo any other *Trees*, tho' never ſo different in Nature. Yet they who would have their *Graffs* to thrive, had beſt ſet them on a *ſtock* of the ſame kind; becauſe the *ſtrings* of *Plants* that are of a like Nature, do better agree together, and have their *pores* and *paſſages* diſpos'd in one and the ſame manner. However it is obſerv'd, that in proceſs of time the *Seed* of the *Graff* doth very much degenerate: The Reaſon whereof is, becauſe the *Seed* proceeds from the *Matrix* or *Pith* of the *Tree*, which being the product of the *wild Stock*, by degrees affects the *Seed*, and makes it to degenerate.

XIII. *What Pores of the Stock correſpond or agree with the Pores of the Graff.* Some, it may be, will queſtion how it comes to paſs, that the *Scion* unites with the *Stock*, ſeeing that their *pores* do not anſwer to one another, but differ in their *ſituation* and *figure*. To which I Anſwer, That it is not neceſſary that all the *pores* of the *Stock* ſhould agree with thoſe of the *Graff*, or that every one of both their *ſtrings* ſhould be united; it being ſufficient if the greateſt part of them anſwer to each other, and give way to the paſſage of the *Alimental Juice*. As we ſee that 2 pieces of *Glaſs* laid upon one another, tho' all the

the *pores* do not exactly agree, do notwithstanding transmit the *Light*. For we must not imagine, that the *Graff* is joyned to the *Stock*, into which it is *graffed* with the same firmness and evenness, as its own connatural Parts are; since it hath often been found, that in an *Old tree*, the Part that hath been graffed on it, hath been torn off by a strong *Wind*, tho' for many years together, it had been united to it no otherwise, than as if it had been a Connatural part of it. For in order to the conveyance of the *Juice* from the *Root* to all the parts of the *Tree*, it is not necessary that all the *Pores* should exactly agree; because we find that the *Earth* affords Nourishment to *Plants*, notwithstanding that their *Pores* do not every way agree with those of the *Earth*. And tho' we should grant, that such a conformity of *Pores* should be necessary for the common Nourishment of the *Stock* and the *Graff*; yet I see no reason, but that the same conformation may be wrought in process of time, because the *Sap* that comes from the *Root* hath power of making to it self *Channels* and *Passages*, as hath been hinted before: For the *Fire*, by the *motion* whereof it is driven upwards, thrusting it forwards, helps it to make these *Passages* and *Channels* for it self.

XIV. *In Graffing, many things are to be observed.*

To the end that *Graffing* may be duly performed, we must take heed, *First*, That the *Scion* to be *Graffed*, be not too *soft* or tender; for then, because of the tender texture of its *strings*, it will not be able to bear the hardness of the *Stock* into which it is *Graffed*. Neither on the other hand must it be too *dry*; for in that case it will not unite and grow into one with the *Stock*. *Secondly*, That the *Graff* be taken from a *fruitful* and good *Tree*, and, as near as may be, of the same kind; as the *Graff* of an *Apple-tree*, upon the *Stock* of an *Apple-tree*. For if they be of different kinds, the *Fruit* thereby becomes spoiled; as if one should graff an *Apple-tree* upon a *Willow* or an *Ash*, the *Apples* will be found like to a *Crab* or *Wilding*. *Thirdly*, That the *Scion* be without any delay graffed, lest the *Air* entring into the *Pores*, should hinder their growing into one. *Fourthly*, That the *Stock* be duly slit, lest the *slit* being made too deep, should hinder the closing of it up again. *Fifthly*, That the *Graff* be so cut, as that the *Woody part* of it may joyn with the *Wood*, and the *Bark* of it with the *Bark* of the *Stock*. *Sixthly*, That the *Stock* on which we intend to *graff*, have stood in the *ground* for some Months, lest in case it should not be well *rooted*, it might not furnish *Sap* enough to feed its young Nursling. *Seventhly*, The top of the *Scion* is to be cut off, that by beating back the *Juice* it may swell and grow bigger. *Eighthly*, That when the *Graff* is put into the *slit*, the place must be pasted about with *Wax* and *Gum*, or with *Clay* and *Moss*, to keep out all external Moisture. *Ninthly*, That a fit *Season* of the Year be observed; which is, after the *Winter Solstice*, and after the Blowing of the West *Wind*; that is, from the *7th* of *February* to the *Spring Solstice*. *Tenthly*, It is also to be noted, that some *Trees* are altogether unfit for *Graffing*; as the *Oak*, the *Fir-tree*, and other *Resiniferous-trees*; because the *Oak*, by reason of its hardness, will not be slit; and when slit will not grow together again: And *Resiniferous-trees*, because of their clammy *Liquor*, have their *pores* so obstructed, that the *Juice* cannot be readily conveyed to the *Graff*. And, *Eleventhly*, That the parts of the *Scion* may retain the same situation when graffed on the *Stock*, as it had before it was cut off from its own *Tree*: As by Example, If the *Graff*, before it was cut off from the *Tree* did lean towards the South, in *Graffing* it must likewise be turned that way. See the *Natural History concerning Plants*.

CHAP. XIII.

Of the Colours of Plants.

I. *What Colour is.*

AS to our present purpose, it is sufficient for us to know, that *Colours* are nothing else, but certain *modificatious* of *Light*, caused in *Bodies* by the different disposition of their *Surfaces*. Whereof we have a manifest proof in cutting of an *Apple*, the inner parts whereof appear *white* at first; but soon after turn *yellow*, and lastly become of a *brown Colour*, according as its outward parts are more dried. Such a modification of *Light* does especially belong to *Plants*, since that all their *parts* are ting'd with some *Colour* or other, and are remarkable for their *whiteness*, *yellow*, *red Colour*, *&c.* yea, and sometimes are successively *green*, *yellow*, *red* or *white*, according as the *Texture* of the little *particles*, whereof they are compounded, is changed, and the disposition of the *surface* alter'd. The Matter therefore in question is, What that is in *Plants* that makes the *Light* reflected from them to acquire such and such *Modifications*, which impress these Sensations on the *Eye*.

II. *Why the Roots of Plants are commonly White.*

The *Roots* of *Plants* are generally *white*; because they contain much *Spermatick matter*, which being compress't by the *Earth* that lies round it, and hindred from flying up into the *Air*, is forced to return into the *substance* of the *Plant*; where, by the warmth of the inner part of the *Earth*, it is concocted anew, and being coagulated into a kind of *frothy Substance*, doth reflect the *Light* on all sides, and so produce a *white Colour*. For the Reason why *Snow* and *Froth* are *white*, is, because they consist of little round *Bodies*, which from every point reflect the *Sun-beams*. For the smaller these *Bubbles* are, the more white doth the Subject appear; for seeing that every one of them, from all their parts reflect the *Light*, it must needs follow, that the more there are of these, within that determinate Space, the more *Rays* will be reflected; that being a *white Colour*, which comes neares't to the Nature of *Light*. Hence it is that *Liquor*, tho' it be of never so *black* a *Colour*, turns *white* as soon as it is turned to *Froth*; as appears in the *froth* of *Ink*; and therefore it is no wonder that the *Root* of a *Plant* being cover'd with *Earth*, appears *white*, because it consists of *clammy Humours*, which by the warmth of the *Earth* is easily turned into little round Pellets.

III. *For the same Reason a Lilly is White.*

And it is for the same Reason that a *Lilly* is *white*; because the *surface* of it riseth into *Bubbles*, from all the several *parts* whereof it reflects the *Light*. For in a *Lilly*, the *Alimental Juice* is very exactly percolated, and its *substance* being well concocted, turns to round *pellets* or *bubbles*. In like manner as we see, that our *food* becomes turned into *Chyle*, when after digestion in the *Stomach*, it is resolved into little round *Bodies*; which

Chyle

Chyle afterwards in the *Breasts* becomes turned into *Milk*. The Reason therefore of the *whiteness* of a *Lilly* is, because the little *Skin* wherewith its *Substance* is covered, consists of round *Pellets*, as is manifest to those that look upon it through a *Microscope*.

IV. *Whence the Red Colour that is in Flowers proceeds.* Some *Flowers* are *Red* as *Roses*, and *Tulips*, because their parts are so disposed that the *Globuli* of the Second *Element*, which constitute *Light*, are by them more swiftly whirl'd about than they move to right *lines*. Wherefore whensoever the *light* in any *Body* is so modified, that its *Æthereal Globuli* are more swiftly turned round, than they move right forwards, than the surface of those *bodies* from whence the *Light* is reflected appears *Red*. Thus a *white Flame*, when *smoke* comes to it, turns *Red*. The *Sun* through a Mist, the *Planet Mars* by night, the *Moon* in the *Clouds*, a glowing *Coal*, and many other things are *Red*. Some *Fruits* therefore as *Cherries*, *Grapes*, *Mulberries*, &c. are of a *Red Colour*, because the *Juice* whereof they consist, having never been exactly strained, and therefore containing several *Particles* that are not sufficiently digested, makes those *Fruits* to appear of that *colour*, by reflecting the *Light* accordingly.

V. *The Cause of the Yellow Colour that appears in the Leaves of Plants.* A *Yellow Colour* is peculiar to the *Leaves* of *Trees* and *Fruits*, whilst they are *ripening*; because having lost the moisture, which gave them their *Greeness*, they now contain nothing but such a *Juice*, as is well strain'd and prepar'd; which makes their outside to rise into greater *Bubbles* or round *Bodies*, which because they leave great *intervals* between them, must needs cause a great variation in the *Reflexion* of *Light*. For if you look upon *Yellow Bodies* with a *Microscope*, you will find them wholly rough and uneven, and full of innumerable protuberances; by which means the *Light* reflected from them becomes so modified, that the *whirling* about of the *Globuli* is somewhat more rapid than their *motion* to right *lines*. For the *Yellow Colour* mediates betwixt *White* and *Red*; which may be demonstrated to the *Eye* from the mingling of *Liquors*; for if you mix any *White* and *Red Liquor* together, the result will be *Yellow*. And the same will be if we twist a Lace or Girdle of the smallest *White* and *Red Threads*.

VI. *The Blue Colour is peculiar to some Flowers.* *Blue* is the peculiar *Colour* of some *Flowers*, because the *Juice* that nourisheth them, is in such a manner concocted and percolated, that from thence such a *degree* of *Darkness* and *Transparency* results, as produceth such a Reflexion of the *Rays*, that the *Globuli* of them, have more of a straight, than of a circular *motion*. For a *Blue Colour* comes between a *Black* and *Red*; as appears in the *Air*, which in the day-time looks *Blue*, by reason of the *Bodies* that are tost up and down in it, and reflect the Rays to us. And forasmuch as these *Rays* are but few in number, and the *Shades* many, therefore it is necessary that the *Heaven* should appear of a middle colour between *Black* and *Red*, that is of a *Blue*, in the day-time. This will be made manifest to us by mixing a very fine *Red Powder*, with another that is *Black*, or by laying a black *Glass* upon a red *Glass*, and looking through them, for by either of these ways we shall find a *Blue Colour* produced.

VII. *The General Colour of Plants is the Green Colour.* The most common *colour* belonging to *Plants* is the *Green*, which is observed in all of them as well at their *springing* out of the *ground*, as in their *growth*. The cause of this *Colour* is the abundance of *moisture* that is in *Plants*, when it is but slightly strained and elaborated. Hence it is that those *Herbs* and *Leaves* have more of this *Greeness* by how much the more they abound with *moisture*, and less of it, as the *moisture* is less, and better digested. This *Green Colour* is mixed of *Yellow* and *Blue*; which may be made out by several experiments; for if we look upon the *Sky*, which is *Blue*, through a *Yellow Glass*, it will appear *Green*; so likewise if we lay a *Blue Glass* upon a *Yellow*, and look through it upon any *Object*, it will appear *Green*: and so we shall find that by mixing a *Blue* and *Yellow Colour'd Liquor* together, the mixture will be *Green*.

VIII. *What is the Cause of that variety of Colours that is in Tulips.* There be many *Flowers* that are of divers *colours*, as *Tulips*; which cannot proceed from any other cause, but the different concoction of the *Alimental Juice*; because the matter is better preserved and purified in the great *Bulbous Roots* of *Tulips*; and better strained through their long and thick *Stalks*, wherein also it is the better concocted and distributed. But yet it cannot be expected that *Tulips* every year should retain the same *colours*; for the temper of the *weather* changing considerably every *year*, it cannot be otherwise but that thereupon a different *concoction*, *preparation* and *distribution* of the *Alimental Juice* must follow, and consequently the *colour* also be changed. Yea, we find sometimes that *Tulips*, in one and the same year do change their *colours*, and that such as before were *White*, turn *Red*, and the *Red*, *White*. When streaks of a *Purple Colour* appear in a *white Tulip*, it is a sign that the thicker parts of the *Juice* do cause an obstruction, whereby the free *motion* thereof to the utmost parts of the *Flower* is hindred.

IX. *Why Leaves and Flowers change their Colours.* And the same may be said of the *Leaves* and *Fruits* of *Trees* changing their *colours*. For the *Leaves* are *Green* at first, by reason of the plenty of *Moisture*, and the *Juice* that is not throughly elaborated or prepared; and from this *Green Colour* they are changed into a *Reddish*, and lastly from that to a *Yellow*; because the *Moisture*, which at first was the cause of the *Green Colour*, being diminished gives way for the *Red Colour* to succeed, and afterwards flying all away, they are thereby changed into a *Yellow Colour*, till at last extream driness turns them *White*. In like manner *Fruit*, as it comes to be *ripe*, quits its *Green Colour*; which becomes changed into some other; because the *Juice*, which before was raw, as wanting due preparation, when the *Fruit* grows *ripe*, becomes depurated and percolated to *perfection*: so that the contexture of parts being by this means changed, it is no wonder that the *Fruit* loseth its green *Colour*, and becomes *Red*, or *Yellow*, or of a *Colour* mixt of both.

CHAP. XIV.

Of the several Tasts of Plants.

I. *What Taste or Savor is, and wherein it consists.* BY the *word Taste* or *Savor*, we understand that *virtue* in *Bodies*, whereby they are able to produce in us the *sense* of *Taste*. Which virtue consists in the *Particles* of *Bodies*, inasmuch as they are sufficiently diluted, subtil and agitated to

to enter the *pores* of our *Tongue*, and to move those *Nerves*, wherewith the *Instrument* of *Tasting* is is furnish'd. For tho' *Taste* be properly in the *Mouth*, and that the *Tongue* or *Palat* is formally that which *tastes*; yet it may be said, that the things themselves, which are taken into our *Mouths*, are the Causes of the said *Taste*, and according to their several *magnitude*, *figure* and *motion*, do produce different *tastes* or *savours*. So that things *savoury*, or endued with *taste*, are said to be such, only because they move the *Filaments of the Nerves* of our *Tongue* in such a manner, as is necessary to produce in them the *sense* of *Tasting*. And forasmuch as *sensible Objects* cannot affect those *Nerves*, except they be endued with a certain *motion*, *figure*, and *magnitude*; therefore to these three we must assign all the diversity of *Tastes* or *Savours* we meet with in any *Objects*.

II. *Why some Fruits are insipid.*

This is evident from the *Insipidness* we sometimes find in *Plants*, and their several *parts*. For if we enquire into the Reason why some of them are *Insipid*, and do not affect the *Tongue* or *Palat*, we shall find the Reason to be, because they do not furnish such *Particles*, as by the assistance of *Moisture* can enter the *Tongue*, and strike its *Nerves*. Thus we find, that when *Grapes* are first knotted, they impress no affection upon the *Tongue*, and do only touch the outside of it, without entring its *pores*; because the *particles* of *Juice*, which come up from the *Root* to compose them, do stick close together, and are not easily separated. Daily Experience also teacheth us, that *Water* is in a manner wholly insipid, because its *Particles* are so thin and subtil, that they can affect the *Organ* of *Taste* very little or nothing. In like manner *Air* is void of all *Taste*, because it floats only upon the *Spittle*, and the Parts of it, by reason of their extream lightness and subtilty, can make no impression upon the *Tongue*.

III. *What is required to make a thing sapid or savoury.*

That a thing be *savoury*, it is necessary for its Parts to be separated from each other, that so joyning themselves to the *Spittle* in our *Mouths*, they may variously affect the *Nerves* of our *Tongue*. Now this is done by means of *Heat*, the Property whereof is, to resolve *Bodies*, open their *pores*, and to make a ready way for the *Moisture* to enter. Whence it is, that when *Fruits* tend to Maturity, by means of the *heat* of the *Sun*, reconciling their *driness* and *moisture* together, various *Tastes* are impress upon them, according to their different degrees of Maturity: First, an *Astringent taste*, then a *Harsh taste*, afterwards a *Sowr*, and last of all, a *Sweet taste*; and if the *Heat* be too great a *smart* or *biting*, and *bitter Taste*.

IV. *Why Sloes have an Astringent taste.*

An *Astringent taste* we find in *all unripe Fruit*, and more especially in *Sloes*, which with great *harshness* and *astringence* affect the *Tongue*, as if they prick'd it with *Pins* and *Thorns*; because they consist of *keen* and *stiff Parts*. For the *Juice* whereof they consist being not well strained, contains many stiff and inflexible little *Bodies*, such as are the *particles* that compose *Salt*; so that it is no wonder that they exasperate the *Tongue*, and astringe or contract the same.

V. *Onions and Pepper have a smart and biting Taste.*

In *Onions*, *Ginger*, *Pepper*, *Mustard-seed*, *&c.* we perceive a *smart* and *biting Taste*; because the *particles* of these Objects do prick the *Tongue*, and cause the same Division in it, which *Fire* would, if applied to it. The Reason is, because they consist of long, thin, and stiff *particles*, which make the *Bodies* whereto they belong dry and stiff. But being *boil'd* in *Water*, they lose their *Acrimony*; for that the *Moisture* penetrating them, dissolves their *Salt* and other smart little *Bodies*, and opening their *pores*, carries them away. Yea, some of these may be so macerated or soaked, as that by quitting all their *Biting* and *Harsh particles*, they may become *sweet*, and at last *insipid*.

biting Taste.

VI. *How Sweetness is produc'd in Ripe fruits.*

We meet with a *Sweet taste*, almost in all *Ripe Fruits*, which with great smoothness and evenness affect the *Tongue*. For in *Ripe Fruits*, by the continual *heat* of the *Sun*, the *Alimental Juice* is very exactly and throughly strained, and the *particles* that before were entangled, are resolved, by which means they readily enter the *pores* of the *Tongue*, and affect it with a pleasing Titillation. This *Taste* is most pleasant and grateful to young *Children*, the small strings of whose *Nerves* are more fine, small and subtil; but is not so acceptable to those who have a thicker *Texture* of *Nerves*, being affected by what is *acrimonious*, and therefore look upon a *sweet Taste*, to be unpleasant.

VII. *A Sowr taste proper to Limons.*

A *Sowr taste* is found in *Limons*, *Sorrel*, and the like, which do prick and cut the *Tongue*. It is felt somewhat in the same manner, as a *smart* or *biting Taste*, saving only that *Sowr things* are accompanied with a *sense* of constringent *Cold*. The Reason is, because this *Savour* consists in *subtil* and *sharp Particles*, which do easily penetrate the *Organ* of *Taste*, and pierce it like so many *Thorns*. And therefore we must conclude, that these *Bodies* consist of longish and stiff *particles*, somewhat like *Needles*: Which we shall readily admit, if we consider that all *Fruits*, before that they come to their full *Ripeness*, are of a *Sowr taste*; which could not be, if that *Taste* did not include something that is common to them all. Now we can meet with nothing that is common to them all, except that *Disposition of Parts*, seeing they consist of an *Earthy Juice*, which did cleave to the long and thin *pores* of the small Twigs, whence these *Fruits* do grow.

VIII. *Whence that Bitterness that is observed in Rotten Apples, doth proceed.*

A *Bitter Taste* is perceived in some rotten *Pears* and *Apples*, *&c.* in the eating whereof the strings of the *Nerves* are unduly affected, and unpleasantly vellicated. For *Pears* and *Apples*, when they begin to putrifie, get rough, uneven, and prickly *particles*; because then the more subtil and refined *particles* fly away, leaving none but the grosser and thicker behind them. For *Putrefaction* is such a *Resolution* of *Parts*, by which things become worse than they were before. Hence it is that they who drink *Wine*, immediately after they have eaten a *tainted Apple*, and tending to *putrefaction*, do perceive a *Bitter taste*; because the *Wine* mingling it self with those putrid *particles*, conveighs them to the inmost *pores* of the *Tongue*. This *Bitterness* is sometimes occasion'd by too great *Heat*, when it is continual, and acts for a long time together upon *Fruit*. So that if *Fruits*, after their full Maturity, should continue long upon the *Trees*, it is not to be question'd, but that by being too long expos'd to the *Heat* of the *Sun*, their *particles* would become so rugged and twisted, that none would be left in them, to affect the *Tongue* with a *Sweet taste*, but would all ex-

asperate and bite it. A confirmation whereof we have in *Flesh*, which by too great *heat* of the *Fire* becomes scorched and burnt, and by this means acquires a *Bitter taste*, as doth also the *Crust of Bread* that is burnt, by being baked in an overheated *Oven*.

IX. *Mixt Tastes are found in some Fruits and Plants.* Neither are these simple *Savours* or *Tastes* only found in *Plants* and *Fruits*, but also compound *Savours*; as the *sweet* and *sowr Taste* which is commonly found in *Fruits*, that are not yet arrived to the utmost degree of *Maturity*: As when some of their *parts* are longish and stiff, which prick the *Tongue*; whereas others, more smooth and pleasant, softly flowing over the *Nerves* of the *Tongue*, do only produce a kind of pleasant *Titillation* on the *Tongue*. Another *Taste* is that which is *Harsh* and *Sowr*, which is that we perceive in those we call *rough Wines*. Another, *Sowr* and *Astringent*, which *taste* is found in the *Juice* of *unripe Grapes*, called *Verjuice*; the Cause whereof is this, that the *particles* which constitute the *Grapes*, are by the Heat of the *Air* separated from each other, and so acting independently, they produce both a *sowr* and *astringent Taste*.

CHAP. XV.

Of the Odour or Scent of Plants.

I. *Wherein Taste and Scent do agree,* *Odours*, or *Scents*, have some *affinity* with *Tastes*, as being much deriv'd from the same *Principles*. For as *Taste* consists in those little *Bodies* which penetrate the *Tongue* and *Palat*, and diversly affect them, according to their various *Magnitude*, *Figure* and *Motion*; so *Odour* consists in those *particles* which, flying in the *Air*, do enter our *Nostrils*, and variously affect the same. There is also another *Resemblance* between them, in that they are in a manner denominated alike, and are distinguish'd by the same Differences. For as *Tastes* or *Savours* are chiefly distinguish'd into *Astringent*, *Smart* or *Biting*, and *Sweet*: So of *Odours* or *Scents*, some are *sweet*; as in *Musk*, *Roses*, *Orris*, *&c.* Others *smart* and *stinging*; as in *Brimstone*: Others, *stinking* or *nasty*; as in *Bugs*, and some *Excrements*: Others, *sharp*, as the Scent of *Spike*, *&c.*

II. *How Savours and Odours differ.* But yet *Scents* and *Tastes* differ in this, that they do not consist in the same *parts*, nor affect the *Organs* after one and the same manner. For the *particles* that are productive of the *sense* of *Taste*, are moist; whereas those that cause *Odours*, are very dry and subtil. They differ also, in that a *savoury Object* cannot move the *sense*, except it touch the *Organ*; whereas a *scented Object* strikes the *Organ* at a distance: So that the *Tongue*, by its Moisture, takes out the *Taste* from the *Object*; whereas the *Nostrils* only admit the *Odour* transmitted to them from the *Object*.

III. *The Nature of Odours consists in the efflux of Particles.* Whence we may conclude, that the Nature of *Odours* consists in the *Efflux* of certain *particles*; which being diffus'd in the *Air*, enter the inmost parts of the *Nostrils*, and there affect some *Nerves* derived from the *Brain*. This we perceive in *Frankincense* cast upon *Coals*, and any other *Perfume*, which evaporates in the *Air*, and is dispers't into innumerable *particles*. Whence it is that *Hard Bodies*, which in their compact Nature afford no *scent*, when put to the *fire* yield an *Odour*; because, by the forceable *motion* thereof, some of those *particles* are set at liberty, and diffused through the *Air*. 'Tis for this Reason, that *Spanish Wax*, which we make use of to *seal Letters*, doth yield a *sweet Scent*, when put to the *fire*; as also that one *Stone* rubbed against another; and *Iron* violently struck by another *Iron* do send forth a *smell*, which before this motion was not perceptible. From which Instances it may appear also, that the *Odours* of *Flowers* consists in an *Exhalation* or *Evaporation* of some of the *parts* of them, which is the more evident, because when that is gone, they remain void of all *smell*.

IV. *Why some Bodies have no Scent at all.* Neither must we conclude from hence, that all manner of *Effluvia* that proceed from *Bodies*, must impress the *sensation* of *Odour*; for besides the emanation of *particles*, it is required that they move the *Organ*, and that in such a manner as is fit to produce this *sense*. For the *particles* of some *Bodies* may be so very fine and small, that they cannot sufficiently move the *Organ*: Thus we find, that neither the *Air* we draw in, nor the *Vapours* that arise from the *Water*, do excite any *sense* of *Smelling* in us. And on the contrary, some *Effluvia* are so gross, that they cannot reach the *Organ* of *Smelling*; or if they do, are more apt to spoil it, than to produce any *sense* of *Smelling* in it.

V. *The difference of Odours depends on the variety of Parts, that flow from a Body.* The Diversity of *Odours*, for the most part, depends on the same *Principle*, whence the variety of *Savours* doth proceed; that is, from that difference there is in the *magnitude*, *motion* and *figure*, of those *particles* that breath out from *Odorous Bodies*. Which we shall more readily assent to, if we consider that there is some Analogy or Resemblance between *savoury* and *odorous Objects*; and that those which agree in *taste*, do generally agree in *smell* also. Thus all *smart* and *biting Things* to the *taste*, are also observ'd to have a *sharp* and *stinging Smell*; and *bitter Things*, to have a *scent* that partakes something of *Bitterness*. The Reason whereof is, because the same *Particles*, which being mingled with *Moisture*, produce *Taste* or *Savour*, when exhal'd into the *Air*, and entring our *Nostrils* create the *sense* of *Smelling*. In like manner *Bodies* that are insipid, are commonly also destitute of *scent*. Thus *Unripe Fruits*, which have no more than an imperfect *Taste* (and the same may be said of *Flowers*) yield little or no *Odour*. I said, that it is so for the most part, because it sometimes happens, that there is not this agreement between the *Taste* and *Scent* in *Objects*; as appears in *Roses* and *Myrrh*, which tho' they yield a pleasant *smell* to the *Nostrils*, yet have a bitter and unpleasant *Taste*.

VI. *Why Odours are more perceived in Hot Seasons and Climats.* Nothing more conduceth to the production of *Odours*, than *Heat*; because it readily opens and resolves *Bodies*. For as we see that *Smoak* is excited by *Fire*, and that the more *subtil parts* of the *Wood* are carried up into the *Air*: In like mannner *Heat* divides the parts of *Bodies*, dissolves their *Texture*, and makes way for them to fly abroad. For we observe that *fruits* and *flowers* smell by so much the more, as their *Juice* is better prepared by *Heat*, and more throughly digested. A *Lilly*, the more it hath been concocted with a lasting *heat*, the more *odorous* it is. *Sweet Woods* and

Spices,

Spices, the *hotter* the *Countries* are they grow in, the more ſtrongly *Sweet-ſcented* they are; as appears in *Frankinſence*, *Storax*, *Myrrh*, *Balm of Gilead*, *&c.* Becauſe the *Juice* of *Plants* in thoſe *Countries* being exceeding well digeſted, is the more eaſily reſolv'd into an *Odoriferous breath* or *ſteam*. Wherefore it is not to be wondred at, that the *Plants* that grow with us are not ſo *odorous*, as thoſe that grow in *Arabia*, and other hot and dry *Countries*; becauſe the Concoction cannot be perfected for *want of Heat*, the ſuperfluous *moiſture* hindring the more dry *particles* from exhaling into the *Air*. Hence it is that moſt things, when dried, do acquire a ſtronger *Odour*; and for the ſame Reaſon, *Ripe Fruits* are more and better *ſcented*, than thoſe which are unripe. This proves all *Odorous things* to be *hot*, and that they ſuffer a continual efflux of their *parts*. And therefore thoſe who would preſerve the *Sweet-ſcentedneſs* of *Musk*, do wrap it in *Cotton*, which doth entangle its *Effluvia*, and hinder it from exhaling too faſt. Accordingly alſo we find, that in *Colder weather ſcents* are dull and weak, becauſe *Cold* ſtops the *Pores* of *Bodies*, and by keeping their *parts* at reſt, hinder them from breathing out in Exhalations.

VII. *Flowers ſmell more ſweetly at a diſtance.*

Flowers are obſerv'd not to ſmell ſo ſweet near at hand, as at a *diſtance*, if it be not too great. The Reaſon is, becauſe they who put the *flowers* to their *Noſtrils*, do take in many *Heterogenous parts* of *Herbs*, which are mingled or entangled with thoſe of the *flower*, but are not able to accompany them at any diſtance, but are ſoon ſcatter'd in the *Air*, or fall down, becauſe of their Thickneſs. Hence it is that a ſmall quantity of *Civet* ſmells *ſweet*, whereas a greater quantity of it rather ſtinks, and offends the *ſmell*. To which we may add, that the *Odorous Exhalations* ſcatter'd in the *Air*, become there ſtrained and defœcated of their more groſs and impure *parts*; as we ſee that *Water* mingled with *Wine*, doth dull and weaken the *ſmell*, as well as the ſtrength of it; and therefore it is no wonder, that an *Odorous Exhalation*, that hath been diffuſed through the *Air*, is more grateful, than that which we draw from the *Body* it ſelf, apply'd to our *Noſtrils*.

VIII. *Perfumes waſte continually.*

Foraſmuch as *Bodies* continually ſend forth ſome of their *Particles*, we muſt conclude they cannot but waſte by degrees. So we find, that thoſe *Sweet-ſcents* that are excited by *Heat*, do waſte by degrees, and at laſt loſe all their *Odour*. But thoſe *Perfumes* which do not ſtand in need of this Excitation by *fire*, as *Musk* and *Civet*, do not ſo ſoon conſume, but continue their *ſcent* for a long time, without any ſenſible diminution; becauſe the agitation of their *particles* is very moderate, and conſequently but a few of them are diſperſed or loſt in the *Air*.

CHAP. XVI.

Of the Diſeaſes and Death of Plants.

I. *What is the Death of Plants.*

FOraſmuch as Contraries diſcover each others Nature, and that *Life* and *Death* are Contraries, it will not be difficult to find out why *Plants* do periſh; and what the Cauſe is, why they ceaſe to be nouriſhed, to *grow* and *increaſe*, and to expreſs it in one word, why they *die*. For ſeeing that the *Alimentary Juice* is the immediate Principle of *Motion* in *Plants*, and that their *Life* doth conſiſt in the due diſtribution thereof by *Heat*; it evidently follows, that the *death* or *periſhing* of *Plants* muſt conſiſt in the defect of this *Alimentary diſtribution*.

II. *How many ſeveral ways Death may happen to Plants.*

But becauſe this Defect may proceed from many *Cauſes*, we will firſt ſpeak of the *Diſtempers* to which they are ſubject, and ſhew how many ſeveral ways their *Vital functions* may be perverted. For beſides the undue diſpoſition of their *Parts*; as when the Top of them is too much bended down towards the *Earth*; when they are full of *knots*, and when the diſtribution of their *Aliment* is interrupted by *callous Bumps*; when their *parts* are ſeparated; or when they exceed, or are defective: I ſay, beſides theſe, there are many other ways whereby they may be brought to their end; as by an undue *Temperature*, when they are either choaked with too much *Moiſture*, or conſumed by too much *Heat*; when they are ſhut up and grow ſtiff, by extream *Cold*; or wither and pine away, by too much *Drought*. The *Ancients* reckon up thoſe *Diſtempers* of *Plants*, which are deſcribed as followeth.

III. *The effect of Rubigo or Mildew, upon Pulſe and Corn.*

The *Diſeaſe* called *Rubigo*, or *Mildew*, in *Pulſe* and *Corn*, is cauſed by a *Dewy Moiſture*, which falling upon them, and continuing there, for want of ſufficient *Heat* of the *Sun* to draw it up, doth by its biting ſharpneſs, or Acrimony, ſcorch and corrupt the inmoſt ſubſtance of the *Seed*. This *Diſeaſe* alſo ſeizeth *Vines*; but may eaſily be prevented by *cutting* them later in the year; for the late *pruning* of them, makes them to *flower* ſo much the later, which generally prevents this Evil, becauſe it ſeldom happens towards the latter end of the *Spring*. *Moiſt* and *Dewy places* are moſt ſubject to this Damage; as *Vallies* and ſhut up places, where the *Winds* have not their free Courſe; *High ground* being not ſubject to it.

IV. *What Roration is.*

Roration; which is a *diſtemper* of kin to that of *Mildew*, is, when by too much *Rain* or *Dew*, *Vines* are blaſted in their *flowering*, and bring forth only ſmall and dwindling *Grapes*. And after the ſame manner other *Plants* are alſo ſpoiled, whilſt they are yet young and tender, and not ſufficiently rooted.

V. *Uredo.*

Uredo, happens either when the *Sun* with too great *heat* ſcorcheth the *Leaves* and *Cluſters of Grapes*, before that the *Rainy* or *Dewy Moiſture* is ſhak'd off from them; or when *Rain* or *Snow*, lying upon the *Tendrils* or *Buds* of the *Vine*, is by Cold congealed to *Ice*.

VI. *Carbunculation.*

Carbunculation, is the blaſting of the new ſprouted *Buds* of the *Vine*, in the *Spring* time; becauſe then the *Vines* are in danger to be *ſmitten*, either by the exceſſive *Heat* or *Cold*. For by too much *Heat*, the Texture of the *ſtrings* or *fibres* of the *Vine* become ſo diſſolved, as that thereby the Native diſpoſition of the *pores* becomes wholly changed; and again by *Cold* it is ſo compreſt, that the *pores* thereby are ſhut up, and leave no paſſage for the *Alimentary Juice*.

VII. *Vermiculation.*

Vermiculation is nothig elſe, but the *Infeſtation* of *Plants* by *Worms*; which Evil is very incident to *Apple-trees*, *Pear-trees*, and *Fig-trees*. For as *Men*, and other *Animals*, are ſubject to breed *Worms*, ſo *Plants* are obnoxious to the ſame *diſtem-*

per,

per, eſpecially ſuch as bear ſweet *Fruits*, for ſuch as bear bitter or ſharp *Fruits* (excepting only the *Olive-tree*) are never troubled therewith. The manner of theſe *Inſects* infeſting *Plants* is declared to us by MALPIGHIUS; *It is yet more wonderful*, ſaith he, *that commonly, by means of one or two Eggs of a Flie left upon the Leaf of a Vine, Oak, or other like, the whole Leaf becomes drawn together like a Purſe about the ſaid Egg, and ſo withers; yea ſuch is the ſtrange force of one of theſe Eggs, that not only the Leaf on which it is laid, ſuffers thus, but the infection being communicated to the Stalk of the Leaf, and from thence to the ſprig that ſticks to it, and the Leaves that are on it, the whole Branch is twiſted and writhed together, and ſo withers and dies.*

VIII. *Defluvium.* *Defluvium*, is a diſtemper whereby *Trees*, in the *Spring-time* eſpecially, loſe their *Barks*, by reaſon of ſome ſharp humour, that diſſolves the *Glew* whereby the *Bark* was faſtned to the *Wood*, whereupon they *wither* and *die*, being deprived of their *Barks*; except this Decortication be not round, but long-wiſe only, for then it is no prejudice to the *Plants*, unleſs it be very great indeed, eſpecially in *Reſiniferous-trees* whilſt they are *budding*. This *Diſtemper* alſo proceeds ſometimes from too much *Drought*, which young and tender *Trees* not being able to bear, they do eaſily ſhed their *Leaves* and *Fruit*.

IX. *A Wound.* A deep *wound* made in any *Tree* kills it, except the *Firr*, *Pine* and the *Turpentine-tree*, which delight in being *wounded*, and by this means become *fruitful*, whereas they were Barren before: for they abounding with a *Fat and Clammy Humour*, do void part of it by the *wound*, and thus being unloaden of ſome of their ſuperabundant *moiſture*, are afterwards better nouriſhed, and advance more in growth.

X. *How Plants Periſh by a Natural Death.* *Plants*, as *Animals*, periſh two ſeveral ways, *viz.* by a *Natural* or *Violent* Death. *Plants die* naturally when *Aliment* is no longer tranſmitted to them from the *Root*; or when the *Heat*, that drives it upwards, and diſtributes it into all parts, vaniſheth. For *Heat*, as is before mentioned, is the *Principle* of all motion in *Plants*, and therefore when that ceaſeth, all the *Functions* of *Germination* and *Nutrition* muſt needs ceaſe with it.

XI. *How many ways Plants may di: a violent Death.* *Plants*, may divers ways *die* violently; as firſt by a *wound* received; whereby we are not only to underſtand *Cutting*, *Slitting*, *Pulling* off the *Bark*, *Boring* or *Lopping* off the *Top*, but alſo *Bruiſing*, *half Breaking*, *Tearing*, &c. For tho' a *Plant*, whilſt it is pluckt up out of the *Ground*, doth not ſuffer any *wound*, yet becauſe the *Paſſages* whereby it drew in its *Aliment*, are ſtopt up, the parts that are towards the top muſt needs *wither*, and thoſe that are near the *Root* muſt be choaked with the too great abundance of it.

XII. *By over-much Heat.* *Plants* alſo periſh by *too much Heat*, when the *Earth* is parched by the *Heat* of the *Sun*, and all the *Moiſture* or *Juice* dried up. Whence it is that young and tender *Plants*, do much ſooner periſh than thoſe that are grown; for by reaſon of their tenderneſs the *Heat* more eaſily penetrates their *Pores* and opens them, and ſo makes way for the *Juice* to get out. Moreover their *Roots* being not ſo deeply fixed in the *ground*, when their *moiſture* is exhauſted, they cannot ſo readily draw in more, to reſtore the *Alimental Juice*, they have loſt.

XIII. *By extream cold.* In like manner *Plants* periſh by great *Cold*, which is very deſtructive to them when it is exceſſive, and eſpecially when it comes after great *Rain*; for ſince the *particles* of *Water*, that inſinuate themſelves into the *Bladders* of *Plants*, do very much diſtend them, they can no longer contain themſelves within their *Bounds*, but breaking out beyond them, do ſpoil the connexion of their *parts*, whence follows their total deſtruction. Accordingly we find that *Plants* by great *Cold* are parched and ſcorched, much in the ſame manner as if they had endured the moſt ſcorching *Heats* of *Summer*. We might now proceed to the anſwering of ſome Queries, as why *Trees* that are pluckt up by the *Roots*, and *Branches* that are lopt off from the *Tree*, do continue to live for ſome time, and do not *die* preſently; why *Wild Trees* are longer liv'd than thoſe that grow in *Gardens* and *Orchards*; but having fully ſpoken to theſe in the *IX. Chapter* of my *Natural Hiſtory concerning Plants*, I thither refer my *Reader*.

CHAP. XVII.

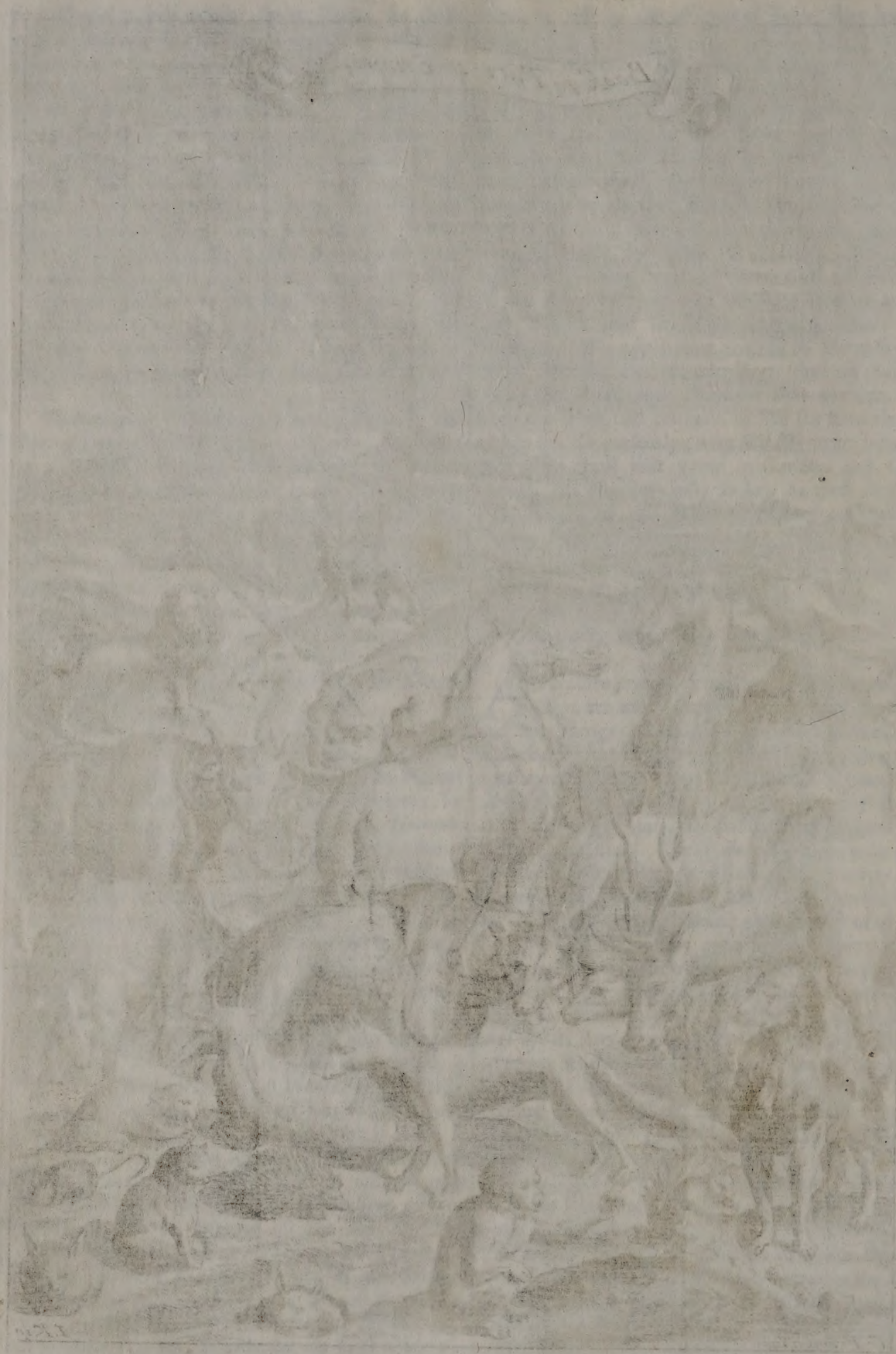
Of Animals, or Living Senſitive Creatures.

I. *What an Animal is.* AS Nature *proceeds* from ſimple *things*, to thoſe that are more compound, and from meaner and viler things to thoſe that are more noble; in like manner having now treated of *Plants*, that are a meaner kind of *Living Creatures*, I proceed to *Animals*, who beſides the *Life* which they have common with *Plants*, are partakers of a kind of *Senſe* and *Motion*. For ſo *Animals are uſually defined Living Bodies, furniſhed with variety of Organs, and endued with Senſe and Motion.* I ſay, *Living Bodies*, becauſe they conſiſt of ſuch a *contexture* of ſenſible and inſenſible *parts*, that they cannot only recover the parts they have loſt, but being excited by *objects*, can agitate themſelves by various *motions*. So that the *matter* of an *Animal* are its *Parts*, or thoſe *Bodily Subſtances*, that complete its *Body*, and are deſigned for the due performing of ſeveral *Actions*. And the *due* and becoming *Union* of theſe *Parts*, whereby an *Animal*, both in reſpect of his ſenſible and inſenſible *Parts*, viz. *Fibres*, *Nerves*, *Paſſages* or Conduits *Valvules*, &c. is ſo diſpoſed, as to be able duly to exert his ſeveral actions, is his *Form*. What their *Senſe* is, ſhall be declared anon.

II. *Wherein the Life of Animals doth conſiſt.* The *Life* of *Animals* conſiſts *in a due diſpoſition of Parts, and* intenſe *Heat*, whereby the *Alimentary Juice* is digeſted, attenuated, changed and agitated. For the *Parts* of *Animals* are not ſo diſpoſed, that the *Alimentary Humour* which is conveighed through them from the *lower part*, is from thence by an uniform tenor diffuſed every where, without any ſenſible heat, as in *Plants*: for in *Animals* there is a Part, which contains an encloſed *Fire*, to which the *Alimentary Juice* being conveighed by the *Veins*, doth there undergo an effervеſcence, and then from thence is driven through the *Arteries*, to moiſten and quicken the whole *Body*; till after having *circulated* through the whole *Body*, it return again through the *veins* out of the *Arteries* to the ſame living *Fire*, there to be heated and recruited *a-freſh*.

This

Book. 1. Part. 7. Chap. 17.
G. Freman Inv.
I. Kip



III. *What kind of Heat it is wherein the Life of Animals doth consist.* This Receptacle of *Fire*, in perfect *Animals* is the *Heart*, which is the most hot of all the rest of their *Parts*. Which *Heat* residing in the *Heart*, is called *Natural*, because it doth not presently vanish like to that *heat*, which is found in *inanimate* or *lifeless things*; but is preserved in the coldest *Season*, and as long as the *Life* of *Animals* doth continue. And accordingly it is said to be the first part that *lives*, and the last that *dies* in *Animals*.

IV. *This Natural Heat is various, according to the difference of Age.* Altho' this *Native Heat* do continue till the Death of the *Living Sensitive Creature*, yet it is not always in the same state, for as it encreaseth all the while *Animals* grow up to their perfection, so after that the same is attained, it decreaseth again and grows weaker, till it be wholly extinguisht. At the *beginning* of *Life*, when the more solid *parts* of the *Body* are yet soft and tender, they do not so much resist the motion of the *Fluid parts*, as when they are come to their full growth; and so because the *fluid parts* are less foceably moved, the heat excited by them is so much the weaker also. But in *Old Age*, when the more solid *parts* of the *Body*, and those more especially through which the *Alimentary Juice* or *Chyle* is strained, in order to the making of *Blood*, begin by degrees to grow harder, and have their *pores* less crooked and winding, the *native heat* must need thereby be changed and grow weaker.

V. *Wherein the Power of Sense and Motion that is in Animals doth consist.* The *Faculty* therefore of *Sense* and *Motion* (which by some is called the *Sensitive Soul*) in *Animals* consists in a *due disposition of the Parts*, viz. their *Nerves*, *Muscles*, *Spirits*, *Fibres*, *Joints and of their other Organs*; by the help whereof *Animals* become differently affected from outward and inward *objects*, and are carried from one place to another. For all *Animals* (*Man* only excepted) are a kind of *Watches* or *Clocks*, which by a fit adaptation of their *parts*, have a *Bodily Principle* of *Motion* in themselves, as long as they are well disposed, and have whatsoever is required to perform and exert the several *actions* to which they are design'd. For all the Effects we perceive in *Animals* (Man excepted) have no other cause or *Principle* but the *Body*, neither is their Sensitive Soul any thing, but the constitution and *affection of their Bodily Organs*, and the *Spirits* or the purest parts of the *Blood*, fitted to the *Animal Life*, and the exercise of the *Senses*.

VI. *What kind of Fire it is that is lodged in the Hearts of Animals* And forasmuch as *Heat* is the *Principle* of all *Motions* in *Animals*, and that whatsoever belongs to *Life* or *Sense* is to be attributed to its continual *motion*; we must enquire, what this *Fire* in the *Heart* is, and what its Effects are. This *Natural Fire* then, which *Physicians* generally adscribe to the *Blood*, is *hot*, but without *Light*, and not much unlike to that, which ariseth from the mixture of two *Liquors*, viz. *Oyl* of *Tartar*, and *Oyl* of *Vitriol*. The Reason is, because after that the greatest part of the *Blood*, which hath been rarefied in the *Ventricles* of the *Heart*, is conveighed thence, through the *Arterial Vein* and the *Aorta*, that *Blood* which still remains in the same *Ventricles*, and that which is a-new conveighed into them, from the *Ear-Lappets* of the *Heart*, have the same respect to one another, as the foresaid *Liquors*; the one being instead of a *Ferment* or *Leaven* to the other, to dilate and warm it.

VII. *How this heat in the Heart comes to be perpetual.* The *Cause* of the *Perpetuity* of this *heat* in the *Heart* is, partly because it is closely shut up and pent in there; and partly because this Fire is nourished and fed in the *Heart* by the *Blood* of the *Veins*, generated of the *Alimental Juices*, heated by a kind of *Fermentation*, and running into the *Heart*: yet so, as that at the same time this *Fire* doth also in its turn impart a heat to the *Blood*, and thereby preserve the Fluidity and *motion* of it.

VIII. *The First effect of the Fire in the Heart, is the Dilatation of the Blood.* The *first* effect therefore of this *Fire* is the *Dilatation* of the *Blood*, contain'd in the ventricles of the Heart, together with the *warming* and *attenuating* thereof. For it is common to all *Liquors*, that when they are distilled drop by drop into a very *hot Vessel* they presently *swell* and are *dilated*. Now the *Blood* being thus rarefied, wants a greater space, and therefore breaks forth from the *Heart*, much in the same manner, as the *water* resolved into *Vapours*, bursts forth from an *Æolipyle*; and the *Blood* that comes to supply the place of the former, rarefies in like manner as the former, and is extended to a far greater space.

IX. *Whence the Pulse of the Heart and Arteries doth proceed.* From this successive Ingress and Egress of the *Blood* into and from the *Heart*, not only the *Heart*, but all the *Arteries* together, swell and are depressed; whence follows the *Pulse* of the *Heart* and *Arteries*, which is as often repeated, as any new *Blood* enters into the *Heart*, and the *Arteries* are extended. For as soon as any part of the *Blood* enters into the hot *Heart*, it presently swells and becomes dilated, by which means it puffs up and distends the *Heart*, and endeavours to get out. Which since it cannot obtain through the same ways by which it entred into the *Heart*, because of the different situation of the *Valves* or *Floodgates* of the *Heart*, it forceth open the other *Valves* that favours its escape, and so gets out.

X. *The Blood is carried throughout the whole Body of the Animal.* And this is the true cause of the *Bloods Motion* throughout the whole *Body*; for seeing that the *Arteries* and *Veins* that are fill'd with it, are continuous, and do not in the least hinder it from continuing its *Motion*, it cannot be otherwise, but that it must alternately, or by turns, with force break forth from the *Heart*, and from thence be driven into the *Arteries* and *Veins*. And it is by this means that the *Blood* derives the *Heat* it hath acquir'd in the *Heart*, to all the other parts of the *Body*. For the more frequent this *motion* of the *Heart* and *Arteries* is, the more *Heat* we find in our selves, and in so much the less time the *Blood* is carried to the utmost parts of the *Body*.

XI. *The continual motion of the Blood is the Cause of the Animals growth.* By this constant *Circulation* of the *Blood* all the *Parts* of the *Body* are *nourished*; because the thinner and purer parts thereof, being separated from the *Excrements*, are added to the *parts*, taking up the place of some *particles* which they drive away thence, or also *grow* and encrease, when greater or more *particles* of *Blood* come to restore the parts, than can be received into their narrow *Pores*. And therefore we find, that whilst a *Body* suffers a continual loss of *Blood* it is not nourished, but wastes away, and consumes.

XII. *By the same motion the Animal Spirits are generated.* By this perpetual *Circulation* of the *Blood*, the *Animal Spirits* are also generated, which are the most subtil and swiftly moved *particles* of the *Blood*, which like a *most subtil Wind*, or rather like a *most pure Flame*, do continually mount up to the *Brain*, fill its *Cavities*, and from thence through the *Nerves*, penetrate into the *Muscles*,

and impart *motion* to all the *Members*. For we need not to seek for any other *Cause*, that makes those parts of the *Blood*, of which the *Spirits* are generated, to mount up towards the *Brain*, rather than to betake themselves elsewhere; but this, because all the *Blood* that proceeds from the *Heart*, doth by a Right line tend that way. And forasmuch as in the *Brain* there is not room enough to contain them all, and the *passages* they are to go through are very narrow, the more *subtil* only of them get through, whilst those that are weaker and less agitated, are diffused throughout all the other *parts* of the *Body*. And therefore we see, that the *Heads* of many *Animals* do move after that they are separated from their *Bodies*, open their *Eyes*, and bite the *Earth*, tho' indeed they be destitute of *Life*.

XIII. *How the Animal differ from the Vital Spirits.*

The difference between the *Animal* and *Vital Spirits* is very small, or to speak properly none at all. For the *Animal Spirit* is nothing else, but *the Vital better depurated, and freed from its grosser Particles in the Brain.* Yet they are distinguish'd in this, that the *Vital Spirit*, being diffused with the *Blood* throughout the whole *Body*, doth promote and execute the *Vital Functions*, viz. *Nutrition*, *Accretion*, and *Generation*: Whereas the *Animal Spirits*, collected in the *Brain*, and from thence diffused through the *Nerves* into the *Organs*, are chiefly subservient to the *Animal Functions*, *viz. Sense* and *Motion*.

XIV. *Why the Animal Spirits are unequally distributed through the Body.*

But here it may be demanded, why these *Animal Spirits*, do not always flow alike from the *Brain* into the *Muscles*; but are very unequally distributed, so as that frequently many more *Spirits* are sent to some *Muscles*, than to others?

I answer, That this proceeds chiefly from two Causes: The *First* is, the unequal *agitation* and *figure* of those *Spirits*, and the *Parts* that compose them. Which inequality may proceed from the various Dispositions of the *Heart*, *Stomach*, *Spleen*, and all other *parts*, which contribute any thing towards their *Production*. Or from the different *matters* of which the *Spirits* consist; as may be seen in those that have *drunk* a great deal of *Wine*; that the *Vapours* of the *Wine* swiftly entring the *Blood*, mount up from the *Heart* to the *Brain*, where they become turned into *Spirits*; which being stronger, and in more abundace than those that commonly are there, may be able to agitate the *Body* in many various and wonderful manners. The *other* Cause is the *Variety* of those *Motions*, which are excited in the *Organs* of the *Senses* by their *Objects*. For it may be easily conceiv'd, that the *figure* and peculiar *agitation of the Parts*, which constitute the *Spirits*; or the *Action of Objects* upon the *Organs* of the *Senses*; or the *Inclination of the Animal* to this or the other *Motion*, determining the *Spirits* to enter into this *Nerve* rather, than into another, cause the *Spirit* to run into one *Muscle*, rather than into another: For such is the make or structure of the *Muscles*, that they swell upon the entring in of the *Spirits*, and consequently are contracted, and so by drawing those parts of the *Body* to which they are fastned, effect the motion of them.

CHAP. XVIII.

What the Souls of Brute Beasts are.

I. *The Definition of a Brute Beast.*

A *Brute Beast* is by the *Peripateticks* commonly defined to be an *Irrational Animal*, or *an Animal endued with Sense*. Yea, they make them almost *Rational*, as supposing that some plain Foot-steps of *Reason* are observable in *Beasts*. But we on the contrary are persuaded, that a *Beast* is a meer *Automaton* or *Engin*; that is, an *Animal* destitute of all *Knowledge*, and consequently may be thus defined: *A Beast is an Artificial Engin or Machin of GOD, furnish'd with a various and wonderful structure of Organs, containing in it self a material Principle of Life, Motion and Sense.* For herein *Beasts* do differ from *Men*, that these have an *Immaterial* or *Intellectual Substance* joyned to *Matter*; which the former have not.

II. *What hath persuaded some, that Beasts make use of Reason.*

It cannot be deny'd, that there are some *Actions* in *Brutes*, which have a great resemblance with those that are in *Men*; whence some have concluded, that they had the use of *Reason*, tho' in an inferiour degree, in comparison of *Men*. How comes it to pass, say they, that when a *Dog* in *hunting* comes to a place where 3 Ways meet, having laid his *Nose* to 2 of them, he immediately casts himself along the third? How can it be conceiv'd, that *Birds* should be able to build their *Nests*, with such extraordinary *Artifice* and convenience for themselves and their *young*, if they be wholly destitute of Discourse and *Reason*? These and other Actions of *Animals*, have racked the *Brains* of several, and forced them to allow some foot-steps of *Reason* to *brute Beasts*. But this *Question* will be easily determin'd, by supposing 2 things.

III. *Brutes cannot express their own Thoughts.*

First, That no *brute Animals*, how perfect soever they be, can express their *Thoughts* (if they have any) by *Words*: Which yet all *Men*, how *dull* and *stupid* soever they be, can do; neither are any of them so far distracted, but that they can discover their Affections by *Words*. The Reason of which difference doth not proceed from the *Organs*, seeing that several *Animals*, such as *Parrots* and *Jackdaws*, utter *Articulate words*, and yet for all that can never attain to our way of *Speaking*, that is, they can never manifest to others, that they understand what they pronounce. Whereas on the contrary, persons that are born *Deaf*, and to whom Nature hath deny'd the use of *Speaking*, can by *signs* discover their Conceptions to others, and make known what they desire or refuse, by their *Gesture*, *Eyes*, and the like. Now the want of this in *Brutes*, doth not only argue a less degree of *Reason* in them, but also strongly prove them to have none at all.

IV. *There are no signs taken up at pleasure, to be found in Brutes.*

In the *Second place*, we must suppose that the *Signs* which have been invented by Men to represent their *Conceptions*, do differ very much from those Natural *Voices* and *Signs*, which are genuine Expressions of *Bodily Affections*. Wherefore seeing the former are not to be found in *Beasts*, and that they are not able any way to express their *Mines*; neither must we allow them to have any use of *Reason*.

V. *Whether Beasts do Discourse together.*

If any one will say, That *Beasts* do *discourse* and *talk* together; this they must prove before we can believe them: For seeing they have *Organs*

gans that are much like ours, why ſhould they not be able to communicate their *Thoughts* to us, as well as to one another? And tho' in ſome caſes they act with extraordinary *induſtry* and exactneſs; yet cannot we from thence infer, their *acting* according to *Reaſon*, for otherwiſe they would excel us in many things; but only this, that Nature works in them according to the diſpoſition of *Organs:* In like manner as a well-wrought *Watch*, doth more certainly and exactly diſtinguiſh the *Hours*, than we poſſibly could do with all our Study and Endeavour.

VI. *The Soul of Brutes conſiſts in the Diſpoſition of their Organs.*

I conclude therefore, that there is no *Soul* in *Brutes*, beſides the Diſpoſition of their *Organs*, and the *figure* of their *Bodies*; and that all their *motions* depend only on the Influence of their *Spirits*, and the due Diſpoſition of their *Organs*. Neither will this ſeem ſtrange, if we conſider, that even all our *Actions*, which we perform, *without minding or giving heed to them*, are produc'd by the ſame *Cauſe*, as *Reſpiration*, *the Motion of our Heart*, *the Digeſtion of our Meat*, and the like. For all theſe do not appear in the leaſt different from thoſe that are done by *Engins*. This is evident from one Inſtance, *viz.* that thoſe who fall from on high, ſtretch forth their *Hands* to ſave their *Heads*, which they do without any aſſiſtance of the *Soul*; but only becauſe the ſtructure of our *Body* is ſuch, that the ſight of an imminent Fall, being convey'd to the *Brain*, drives the *Animal* Spirits into thoſe *Nerves*, that move the *Arms* and *Hands:* Seeing all this is done without the leaſt advertence in the *Soul*. And thus we ſee the Reaſon, why a *Sheep* flees at the ſight of a *Wolf*, even becauſe the Light reflected from the *Body* of a *Wolf*, doth ſo agitate the *ſtrings* of the *Sheeps Optick Nerves*, and conſequently the *Brain*, that thereby the *Animal Spirits* are ſo driven into the *Nerves*, as to put the *Members* deſtinated for running into motion.

VII. *This confirmed by ſeveral places of Scripture.*

This *Doctrin* may be confirmed from ſeveral places of *Scripture*, which plainly aſſerts, that the *Soul* of *Beaſts* is their *Blood*; *Levit.* 17. 14. *For the Life*, or Soul, *of all fleſh*, *is the Blood of it.* *Gen.* 9. 4. *But Fleſh with the Soul thereof*, *which is the Blood thereof*, *ſhall ye not eat.* *Deut.* 12. 23. *Only be ſure that thou eat not the Blood*, *for the Blood is the Soul.* From whence we may evidently conclude, That the *Life* of *Animals* conſiſts in the continual *flowing* of the *Blood* and *Vital Spirits* to the *Brain*, and other parts of the *Body*. And therefore, that we need not ſearch for any other Cauſe of thoſe *motions* we find in *Beaſts*, but the *Influence of Spirits*, and the *Diſpoſition of their Organs*.

VIII. *How Dogs light upon the true Trace of the Hare.*

As to that Objection, That *Dogs*, after they have laid their *Noſes* to *two* Ways, without any further hæſitation, betake themſelves to the *Third*; we ſay, that this is not done by them from any *Reaſoning*, but only becauſe in that third Way they meet with the *Scent of the Beaſt*, which they did not find in the two other. Neither doth the *building* of *Neſts* argue any force of Reaſon to be in *Birds*; becauſe all the *Neſts* that are built by *Birds* of the ſame kind, are all of them built after one and the ſame manner, which would not be ſo, in caſe they acted according to the dictates of *Reaſon*: For we find that Men who act ſo, build their *Houſes* with the greateſt variety, according to the different Suggeſtions of their Rational Faculty.

IX. *How Life and Senſe may be allowed to Beaſts.*

Neither do we altogether deny *Life* to *brute Beaſts*, but freely allow them ſuch an one; the Activity whereof proceeds from the diſpoſition and ſtructure of their *Bodies*. Nor *Senſe* neither, if it be only taken for a *Bodily Affection* of the Members, outwardly and inwardly fitly diſpoſed and aptly joyned, to perform this or the other *motion*. We grant alſo, that *Beaſts* do many *Actions* by *Nature*, *like* to thoſe which *Men* perform of Choice and deliberately; but withal aſſert, that the various and ſudden *motions* of *Beaſts*, do not argue them to have a *Knowing Soul*, but only a moſt curious and exactly proportionate compoſure of *Parts*, ſo as that the leaſt thing is ſufficient to put it in *motion:* And that this is poſſible, we prove by that *Wooden Statue* of *Venus*, which was ſo Artificially made by *DÆDALUS*, that it could walk up and down: And by the *Wooden Dove*, made by *ARCHYTAS* of *Tarentum*, which did fly about in the *Air*.

X. *Whether Apes are to be accounted Rational Creatures.*

You'l ſay, that *Apes* do many things that manifeſtly prove them to have the uſe of *Reaſon*; as appears in that when they go out to fight, they obſerve exact Military Order, and range their *Armies* as *Men* do; as alſo, in that they *bury* their *dead*, and perform many other ſuch like Actions, which demonſtrate them to be, in ſome degree, *Reaſonable Creatures*.

To this I Anſwer, That all theſe *Actions* are performed by *Monkies* naturally. For as *Watches* point the *Hours*, ſo *Beaſts* perform their *Actions* by Inſtinct: Neither is it a matter of greater wonder, that *Monkies* do *marſhal* their *Armies*, ſuppoſing it to be true what *Hiſtorians* relate of them, or *bury* their *Dead*; than that *Dogs* and *Cats*, after they have voided their *Excrements*, ſcrape up the *Earth* round about, to cover them from the Eyes of *Men*; tho' indeed they ſeldom do it to any purpoſe; that is to ſay, ſo as to hide them wholly. Whence it is evident, that they act meerly by *Inſtinct*, and without any advertency of what they do; and that there is nothing more in them, than there is in any curious *Clock-work* or *Machin*.

XI. *If Brutes have a Soul, it muſt be Immortal.*

Conclude we therefore, that *Beaſts* perform all their *Actions*, whether *Senſitive* or *Motive*, only by the *Texture* and *Diſpoſition* of their *Parts*, without any thing of *Thinking*, tho' in the moſt imperfect degree imaginable. For if we allow *Brutes* to be endued with *Underſtanding*, be it never ſo mean and imperfect, then we cannot deny them the Priviledge of a *Soul*; and ſo ſhall be forc'd to own, that *Monkies*, *Dogs*, *Foxes*, *&c.* have *Souls*, as well as *Men:* And if we grant this, we muſt alſo allow, that this *Soul* is Spiritual and Immortal; becauſe *Thinking*, wherein the Eſſence of the *Soul* conſiſts, is not a Mode of the *Body*, neither doth in the leaſt depend on it.

XII. *If Brutes have Souls, they will not be diſtinguiſh'd from Men.*

Moreover, ſuppoſing the *Souls* of *Beaſts* to be *Spiritual* and *Indiviſible*, it will follow that they are alſo *Immortal:* Neither is there any *Argument* drawn from the *Light* of *Reaſon*, whereby we can prove the *Immortality* of *Human Souls*, which will not as well prove the ſame concerning the *Souls* of *Beaſts*. Beſides, if we allow *Knowledge* to *Brutes*, we muſt alſo make them capable of *Religion*; for to imagin a *Knowing* or *Thinking* *Creature*,

Creature, without being under an Obligation to obey *GOD*, and pay *Religious Duties* to him, is repugnant. For if the *Souls of Beasts* be *Knowing*, they will in the first place know themselves; and it is impossible, but that by knowing themselves they should be led to the *knowledge* of their *Creatour*. Which Opinions would pave a ready way to *Atheism*.

This *Question* is discust more at large in my *Dissertation, of the want of Sense and Knowledge in Brutes*; to which the Reader may have recourse.

CHAP. XIX.

Of Fourfooted Beasts and Reptils, or Creeping things.

I. *The Division of an Animal into Rational and Irrational, is no true Division.*

AN *Animal* is commonly divided, in the *Schools*, into *Rational* and *Irrational*, as into two *Members* that take in the whole Nature of *Animal*, and comprehend all its several *species*. But since ARISTOTLE himself doth not approve of this *Division*, because one of the *Terms* of it is a *Privation* of the other; for he declares, that all *Divisions* so expreſt are illegitimate; none will think strange if we reject it for the same Reason. For the word *Irrational*, or *Unreasonable*, represents no positive *Idea*, which yet is requisite to constitute the difference of several *species* or *kinds*. Besides, every *Division* must be expreſt in such *terms*, as do explain and lay open the Natures of the things divided; whereas by *Negative terms*, neither any *Attributes* nor *Properties* are declared; and consequently the Division of *Animal* into *Rational* and *Irrational*, is to be rejected, and to be reckon'd amongst those which are good for nothing else, but to render the Nature of things dark and obscure.

II. *Of Animals, some are Terrestrial, some Volatile, and others Aquatile.*

An *Animal* therefore may more commodiously be divided into *Terrestrial*, *Volatile* or *Flying*, and *Aquatile* or *Swimming*, from the places where they *live*, and the *motions* they exert.

III. *What a Terrestrial Animal is.*

We call those *Terrestrial Animals*, that live on the *surface* of the *Earth*; whereof some be *Fourfooted*, that go upon *four Feet*; and others *Reptils*, which wanting *Feet*, do move themselves by *Creeping*. *Fourfooted Beasts* do go by setting their *Feet* one before another, after the same manner as other *Animals* that have 2 *Feet*, or more than 4. To the performing of which progressive *motion* are generally required *Toes*, *Feet*, *Shinbones*, *Legs*, which together with the *Nerves*, *Muscles*, *Tendons*, *Ligaments*, *Gristles* and *Membrans*, constitute the *Organs* of *Progressive motion*. The *Bones* belonging to this *Organ* are in several places joyned by *Articulation*, the round *Head* of the one being lodg'd in the Hollow of the other. The *Toes* consist of many *Joints*, to which the *Instep* is joyned, and to that the *Heel*, and the *Bone* call'd *Navicularis* or *Cyboïdes*; the *Leg* is joyned by articulation with the *Ankle*, and the *Thigh* with the *Hip-bone*, and the *Shank* or *Leg*. Progressive motion therefore is performed, when one of the *Legs* standing still upon the ground, the other is thrust out forwards: For the *Legs* are not moved both together, but by turns; so that whilst *Animals* go forwards, the *Muscles* act their several Parts, and the *Thigh* is turned in the *Hip-bone*, and the *Ankle* about the *Leg*.

IV. *Circumstances accompanying the Progressive motion of a Man.*

Whence it follows, that a *Man*, for Example, cannot walk directly in a *Right line*; because as he goes, he rests himself sometimes on one *Leg*, and sometimes on another, so that both his *Legs* or *Feet* are not moved in a *Right line*, but according to 2 *Parallel lines*, which seem to be *Right lines*. It follows also, that a *Man* that *goes* or *walks*, doth continually rest or stay himself upon the *Earth*; because one of his *Feet* doth always stand firm on the *Earth*, till the other comes to take its turn: Whence it follows, that it is only the *Foot* that stands still, that makes the *Bulk* or *Trunk* of the *Body* to move forwards. *It follows* also, that the *advancing Foot* moves as fast again, as the *Trunk* of the *Body*: For seeing that the *Body* advanceth continually, and that the *Feet* advance only by turns, one half of the time must be allow'd for the Resting, and the other for the Advancing; and that consequently the *Foot* that advanceth, by moving as fast again, doth compensate the *delay* of its resting.

V. *Of Fourfooted Beasts, some are Viviparous, and others Oviparous.*

Amongst *Fourfooted Beasts*, some are greater; as the *Horse*, *Elephant*, *Camel*, *&c.* Some of a mean Bigness; as the *Dog*, *Lion*, *Sheep*, *Cat*, *&c.* Some Little; as the *Rat*, *Mouse*, *&c.* And of these, some are *Viviparous*, that bring forth *living Births*; and others, *Oviparous*, that lay *Eggs*.

VI. *What Animals are Viviparous, and what Oviparous.*

Those are *Viviparous*, that bring forth a *living* and *perfect Animal*; and *Oviparous* are those that lay *Eggs*, whence an *Animal* afterwards is *hatched*: Such as are the *Crododile*, the *Lizard*, *Frogs*, *Tortoises*, whether of the *Land* or *Sea*. It is matter of Wonder, that the *Crocodile*, so vast a *Creature*, which commonly grows to the length of 15 *Cubits*, should proceed from an *Egg* no bigger than that of a *Goose*. *Lizards*, whether those of the greater sort, that are *green*, or those other that are distinguish'd with shining *Stars*, are propagated by *Eggs*. The *Tortoise* of the *Earth*, lays *Eggs* with a Yolk in them, which it covers with *Earth*, and by the warmth thereof are hatched; whereas the *Sea-Tortoise* covers hers with the *Sand* of the *Sea-shoar*. *Serpents* also are *Oviparous*, and commonly lay their *Eggs* in *Horse-dung*, or near to the heat of an *Oven* or *Furnace*, because they cannot *hatch* them themselves, as *Birds* do.

VII. *How Reptils move forwards.*

Amongst *Reptils*, or *Creeping Animals*, are the *Viper* or *Adder*, the *Asp*, and the *Snake*: All which resting upon one part of their *Bodies*, shoot forth and advance with the other. Yet all *Reptils* do not perform their Progressive motion after the same manner: For *Snakes* creep by raising their *Bodies* into *Rings*, the former whereof advance, whilst the hinder rest, and support the *motion* of the other: For by the first of these *Rings* the *Body* is extended; and by the hinder, they contract themselves in more close *Rings*, and as it were gather up themselves. *Earth-worms* also *creep* by a Waving motion, that is, by contracting and unfolding themselves; so that whilst one part of their *Body* rests, the other is moved. To this way of *Creeping* may also be referr'd that of *Snails*, who by means of their *glutinous Moisture*, are fixed to the *Bodies* they creep upon, and by this means advance themselves. The Cause of all these *Motions* are the *Animal Spirits*, which being forceably

Book·1·Part·5·Chap·19·
G Freeman Invent:
M Vander Gucht: fcul.

To the Worshipfull Chicheſter Graham
of Norton = Conyers in the North Rideing
of York=ſhire Eſqſ: And to Anne his
Wife, daughter and Heyreſs of Thomas
Thweng of Kilton Castle in Cleaveland
in the Said County Eſqſ. deceaſed

This Plate is humbly Dedicated by Richard Blome.

forceably, and in great abundance, driven into the Channels of the *Nerves* and their *Valves*; and not being able to go back, by reason of the make of those *Valves*, by distending the *Nerves* in *breadth*, and shortning them in *length*, do move that part, to which they are joyned, by way of *traction* or *drawing*.

CHAP. XX.

Of Flying Animals, or Birds.

I. *What Birds are, and why the Eagle is said to be the King of Birds.*

Flying Animals are commonly called *Birds* or *Fowl*; and are distinguish'd from others, for that they *fly* in the *Air*. The *Eagle* is accounted to be the *King* of them, because of the Strength of his *Body*, the Height of his *Flight*, the Sharpness of his *Sight*, and the Nobleness or Generosity of his *Temper*.

II. *The various kinds of Birds.*

There are innumerable Kinds of *Birds*; and forasmuch as it is next to impossible to speak of all the *Individuals* of them, I shall content my self to enumerate their *Principal kinds*, as they are distinguish'd according to their several ways of *Feeding*. Some are *Carnivorous*, or such as feed upon *Flesh*, commonly called *Ravenous*: And these again are of two kinds, *viz.* such as have *Crooked Bills*; as the *Eagle*, the several sorts of *Hawks*, *&c.* Others have a more strait and sharp-pointed *Bill* or *Beak*; as the *Raven*, the *Jack-Daw*, *Mag-Pye*, *Crow* or *Rook*, *&c.* Another kind are *Vermivorous*, or such as feed upon *Worms*; as the *Nightingal*, *Wood-Cock*, *Snipe*, *Wood-pecker*, *Titmouse*, *Wren*, *&c.* Another *Baccivorous*, or such as feed upon *Berries*; as are the *Thrush*, *Black-bird*, the *Starling*, *&c.* Others are *Granivorous*, that feed upon *Corn* and other *Seeds*: And of these again, some love to be scraping and tumbling in the Dust; as *Cocks* and *Hens*, the *Peacock*, remarkable for his beautiful *Tail*, the *Bustard* and *Partridge*. Others love to wash and dip themselves in *Water*; as amongst *Singing-Birds*; the *Linnet*, the *Ligury*, the *Lark*, *&c.*

III. *All Birds go upon two Feet only.*

Birds have only two *Feet*, and those either plain and flat; as *Swans*, *Ducks*, *Geese*, and all *Water-Fowl*: Or else have their *Claws* sever'd and divided; as *Eagles*, *Sparrows*, *Swallows*, *Pigeons*, *&c.* Some Report, that the *Manucodiata*, or *Bird of Paradise*, hath no *Feet*, but always hovers in the *Air*, and is never found upon the *Earth*, but when dead: But Reason and Experience evince the falshood of this Story. For all *Animals* stand in need of *Sleep*, which these cannot take in the *Air*, especially being always in a hovering motion.

IV. *That the Bird of Paradise hath Feet.*

And as to those who imagin, that the *Birds of Paradise* take their Rest hovering in the *Air*, by reason of the Lightness of their *Body*, and the Largeness of their *Wings* and *Feathers*, and never fall down to the ground till they be dead; I would fain know of these Men, why they do not fall down to the ground when they are *asleep*, as well as when they are *dead*; forasmuch as in *Sleep* all the *Senses* are lock'd up, and all *motions* of the *Members* cease? But that all Doubt may be taken away in this Point, let us consult such as have been Eye-witnesses. *ANTONY PIGAFESTA*, a Famous Traveller, in the *Diary* of his *Navigation* assures us, that they have *Legs* of a Hand-breadth long, and that they can go and fly like other *Birds*: And that none but *Strangers* suppose them to be *without Feet*; because the *Inhabitants*, whenever they take them, cut off their *Feet*, and take out their *Guts*, casting them away, and then expose them to the *Sun* to dry; which they then sell to *Strangers*, or stick them in their *Caps* or *Helmets*, for Ornaments sake.

V. *Birds proceed from Eggs.*

Birds are the Product of *Prolifick Eggs*, that is, such as have been invigorated by the *Male*, and presuppose the fruitfulness of the *Female*. For as an *Egg* without the *Cock*'s *Treading* is *addle*; so the *Hen*, by producing that Cavity which is in the *Yolk*, doth contribute likewise to the fruitfulness thereof. This will be the better understood by distinguishing the *Egg* into 2 Parts, *viz.* into the *Yolk* and *White*. The *Yolk* is of a *yellow Colour*, tending to *Red*, as being nourished by *Blood*; which is manifest from those *small Veins*, that are disperst throughout its outward Coat or *Membran*. Besides this *Coat*, there is also another very thin one, by means whereof the *Yolk* hangs to the *Cluster*, so called, and covers the whole *Yolk*, and conveys *Veins* and other *Vessels* to it, by means whereof the *Alimentary Juice* is transmitted. The *White* is the more Outside-part of the *Egg*, yielding copious Nourishment, but somewhat of a colder Temperament, and not so easie of digestion as the *Yolk*: It consists of a *fibrous* or *stringy Matter*, and therefore is easily coagulated, growing hard with the least *heat*. At the Broad-end of the *Egg* a little *Hollow* is found, where the *Chicken* begins to be formed; and this proceeds from the *Hen* only. Besides these, there are found in *Eggs* 2 *Specks*, call'd by us the *Cock*'s *Threadles*, in which the *plastick* or formative Virtue of the *Egg* is supposed to consist, according to the Opinion of the Common People; but it is a Mistake, seeing they are found in all *Eggs*, as well in those that are *addle*, as the *prolifick*. An *Egg* therefore becomes fruitful, when the *Seed of the Cock* is joyned to that Hollow or Scar in the *Egg* before-mention'd, which proceeds from the *Hen*. For it is not to be question'd, but that the *Seed* of the *Cock* doth reach the *Womb* of the *Hen*, and as it were, takes root in the *Cells* thereof; whence the Rudiment of the *Chicken* afterwards *buds* forth.

VI. *The Progress of the Forming of a Chick, the 1, 2, 3, 4, and 5th Day.*

When the *Hen* therefore sits upon the *Egg*, and excites the *Bud*, or *prolifick* part of it by its *heat*, the *strings* or *fibres* become dilated or extended into several concentrical Rounds or Circles, and the *Chicken* becomes formed by degrees. For the *second* day of the *Hens* sitting, the Hollow that is at the broad end of the *Egg*, begins to be dilated, and becomes a *Bubble*, the thinner *particles* of it being exhaled by *Heat*, those only remaining that constitute that most clear water, wherewith the *Bubble* is filled. On the *Fourth* day a Purple Spot, or Reddish point appears, which is the Rudiment and first beginning of the *Heart*, and from whence a short time afterwards proceed many little *Veins* of the same colour, but almost invisible by reason of their fineness and subtilty, and which afterwards end in the Umbilicary or *Navel Vessels*. On the *Fifth* day there appear in this *Rudiment* of the *Heart*, 2 *Ventricles*, and as many *Ear-lappets*; and because the *Ventricle* or *Right* Cavity is con-

tracted, when the *Ear-lappet* that is joined to it is dilated, they ſeem to be 2 B*ladders*. The ſame day, there appears ſomething in the likeneſs of a *Worm*, joined to the little *Vein*, to which the round little B*ody* is annexed, but bigger than it, being diſtinguiſht into 4 B*ubbles* filled with a moſt clear and *Chriſtalline Liquor*. Which 4 B*ubbles* do repreſent *both the Eyes*, the B*rain*, and the *Cerebellum* or hinder part of the B*rain*.

VII. *What is formed in the Chick the ſucceeding days.*

On the *Sixth day* the *Feet* and *Wings* of the Chicken are formed, the *Coats* and *Membrans* of the *Eye* begin to appear, as likewiſe the firſt beginnings of the *Lungs* and *Liver*. Alſo the B*ill* or B*eak* and all the *Guts* and *Inwards*. At the ſame time the *Chicken* begins to move it ſelf a little, and to lift up its *Head*. Then alſo the *Rudiments* of the B*ones* begin to be formed, appearing like ſo many thin *Spider Webs*. On the *Seventh* day all the parts begin to appear more diſtinct, and ſo encreaſing every day till the *Tenth*, wherein all its parts are compleated. For the *Head* then appears greater than all the reſt of the B*ody*; and the *Eyes* bigger than the *Head*; and in this ſtate the *Chicken* ſwims on the *Colliquamentum* or diſſolved White of the *Egg*. After the *Fourteenth* day, all its members appear ſtill more diſtinctly: for then it begins to be covered with *Feathers*, the inwards begin to be hid, and the *hinder part of the* B*rain* begins to be pent up in the *Skull*; the *Chicken* begins to Peep or Cheep, and being no longer able to bear the ſtraightneſs of his pent up Room, after having firſt conſum'd the *White*, and afterwards the *Yolk* alſo, it breaks through the *Shell* and comes forth.

VIII. *It is probable that a Chick and other Animals, are not formed by Parts, but all together.*

This is the Progreſs our Eyes diſcover in the forming of a *Chicken*, becauſe it appears ſuch to the unaſſiſted *Eye*. But when we take in the Verdict of the *Microſcope*, as *MALPIGHIUS* did, there will appear to us in every Fruitful or Prolifick *Egg* (for in the Addle, no ſuch thing is to be found) before the *Incubation of the Hen*, the firſt *Rudiments* of the *Chicken*; in like manner as ſometimes, even without the aſſiſtance of a *Microſcope*, we can diſcern the firſt *Lineaments* of a *Plant* in the B*ud* of it. This is very evident in a *Tulip*, for if in the *Winter* time we view the B*ud* of it, either with a *Magnifying Glaſs*, or only with our bare *Eye*, we ſhall not only ſee the *Leaves*, which afterwards turn Green, but alſo thoſe that conſtitute the Flower of the *Tulip*, with the Triangular part of it encloſed in the *Grain*, and laſt of all thoſe little 6 Pillars, which ſurround it, at the *bottom of the Tulip*. And accordingly it ſeems probable, that as a *Flower* contains a *Flower*, ſo an *Animal* contains another whole and compleat *Animal*, tho' ſometimes the ſame be not diſcoverable, but with the aſſiſtance of a *Microſcope*.

IX. *How Birds do fly in the Air by the Help of their Wings*

B*irds* with the help of their *Wings*, keep themſelves up, and move in the *Air*; becauſe the *Air* reſiſts the ſwift agitation of their *Wings*, and oppoſeth their deſcent or falling down. For tho' the *Air* be very pliable, and ready to give way to other B*odies*, yet it indeed makes a great reſiſtance, and like the *Water*, oppoſeth the entrance even of *Heavy Things*. For we ſee that when *Boyes skim Stones* along the *ſurface* of a ſmooth *River* or *Pond*, the *Water* reſiſts them, and makes them by ſeveral rebounds leap up from the *Water* which oppoſeth their entrance. Yea many times the B*ullets* diſcharged from great *Guns* are ſeen to graze along, and rebound from the *Water*, ſo that ſometimes men that are walking on the B*ank* or *Shoar* are ſometimes *wounded* and *killed*, by B*ullets* ſo rebounding from the *Water*. And in the ſame manner are B*irds* borne up in the *Air*, and tho' they be heavier than it, yet by the ſpreading and continual beating of their *Wings*, they are ſupported in the midſt of it.

X. *Two things are required to the Flight in Birds.*

To the *flying* of B*irds* 2 things are requiſit, *Firſt* the ſpreading of their *Feathers*, the ſingle *Hairs* whereof are ſo intangled, that the *Air* cannot enter through them without ſome difficulty, from whence the reſiſtance ariſeth. *Secondly*, the expanſion of their *Wings*, and their beating of the *Air* with them, and that either leiſurely, as *Kites* do, or more frequently like *Doves*, or very faſt as the *Felfare*. And accordingly by the *Prevalence* of this reſiſtance, the force of Gravity is overcome, and the Body of the B*ird* continues poiſed in the *Air*.

XI. *How Birds move themſelves this way and that way.*

Moreover foraſmuch as B*irds* do not only preſs the *Air*, and hover in it, but alſo move up and down; it is neceſſary that the *Wings* which bear them up, be thruſt backwards; that ſo by the reſiſtance of the *Air* behind them, they may be forwarded in their progreſſive *Motion*. For the ſtructure of a B*irds Wings* is ſuch, that the hollowneſs of them forward, and their prominence backward, do both concur to beat back the *Air*. A Reſemblance whereof we meet with in thoſe that *ſwim*, who if they do only preſs the *Water*, with their B*elly* and *Hands*, without beating it back with their *Feet*, they cannot move forwards; no more than a *Ship* can advance if the *Water* be only divided by the *Oars*, without they be thruſt or moved backwards. B*irds* therefore in order to their moving *forwards*, and paſſing this way and that way, muſt beat back the *Air* behind them. And whereas ſome B*irds fly* much more ſwiftly and ſtrongly than others, as the *Swallow*, the *Pigeon* and the long-winged *Hawks*; the reaſon thereof is, either the more advantageous make and frame of their *Wings*, or the ſtrength of their *Muſcles* wherewith they move them, or the proportion of *Heavineſs* or force that is in their B*odies*.

XII. *Birds are not moved in the Air, as a Ship in the Water.*

We muſt take notice that B*irds* do not move in the *Air* like a *Ship* or Boat in the *Water*. For a *Boat* or B*arge* being driven by *Oars* is puſht forwards, whilſt the *Oars* thruſt againſt the *Water*, which reſiſts, in a manner, as much as if all its parts were in reſt. Neither do B*irds* ſhake their *VVings* towards their *Tails*, as *Oars* drive the *VVater* towards the *Stern*, but do bend them downwards. The *Tail* of B*irds* ſerves to incline their *flight* upwards and downwards, but not ſide-ways, neither is it to them inſtead of a *Helm*, as is commonly believed; for it doth not perpendicularly cut the *Air*, as the *Helm* of a *Ship* doth the *VVater*, but hath an *Horizontal Situation*; and when a B*ird* turns ſide-ways yet his *Tail* continues ſtraight ſtretched out; and therefore we ſee that B*irds* fly tho' their *Tails* be cut off. B*irds* therefore are poiſed in the midſt of the *Air*, as a *Ship* in the *VVater*, to wit in the *Center* of their *Gravity*. And like as a *Veſſel* that hath his *Oars* more ſwiftly plied on the right ſide, turns about the *Center* of its Gravity towards the left: So likewiſe a B*ird* whilſt he beats the *Air*, chiefly and moſtly

X.
Two things are requisite to the Flight in Birds.

XI.
How Birds move themselves this way and that way.

XII.
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moſtly with his Right *Wing* towards the *Tail*, his fore-part by this means is turned towards the Left. As when thoſe who *ſwim*, by bending their *Right Arm*, and ſpreading their *Right Hand*, drive the *Water* towards their *Feet*; and by the ſame means turn themſelves about towards the Left-hand.

XIII. *The Tail of Birds only moves upwards and downwards.* And that we may the better apprehend how the *Tail* of *Birds* ſerves them to turn downwards or upwards: Let us ſuppoſe a *Bird* A B, whoſe *Center* of Gravity is C, flying *Horizontally* from G to F, and that in *flying* he rear his *Tail* B H; this ſuppoſed, it is manifeſt, that the *Air*, which reſiſts the *Tail* B H, makes the whole *Body* of the *Bird* turn about the Point C, that it may take the ſituation L K, wherein the *Head* raiſeth it ſelf from A to L; and on the contrary, when the *Tail* is turned downwards to B I, the reſiſting *Air* makes the *Body* of the *Bird* to turn about the ſame Point C, for to take the poſture N O, wherein the *Head* of the *Bird* doth lower it ſelf from A to O.

Figure 60.

CHAP. XXI.

Of Swimming Animals, or Fiſhes.

I. *The Whale is the greateſt of all Fiſhes.* FIſhes, becauſe they live in the *Water*, and move themſelves by way of *Swimming*, are called *Aquatiles*. The moſt bulky of theſe, and as it were the Prince of them all, is the *Whale*, very common in the *Indian Sea*, to whom PLINY aſſigns the largeneſs of 4 *Acres*, which make out in length 960 *Foot*. PARÆUS makes mention of one that was taken in the River *Schelde*, 10 Miles from *Antwerp*, in the *Year* 1577, which was 58 *Foot* long, 16 *Foot* high, and its *Tail* 14 *Foot* broad; the diſtance from his *Eye*, to the entrance of his *Mouth*, 16 *Foot*; his Under-Jaw was of 6 Foot furniſh'd with 25 *Teeth*, to which in the *Upper-Jaw* were anſwering ſo many Cavities, wherein, upon the ſhutting of his *Jaws*, they were hid. A *Whale* is diſtinguiſh'd from other *Fiſhes*, in that it hath, beſides *Lungs*, *Kidneys*, *Arteries*, *Bladder* and *Genitals*, a great *Pipe* in the fore-part of its *Head* inſtead of *Gills*, by which with great force it ſpouts again out the *Water* it receives into its *Body*.

II. *The Difference of Fiſhes with reſpect to the ſeveral places they delight in, and their coverings.* There be many differences of *Fiſhes* taken from the *coverings* of their *Bodies*, or from the *Place* they delight in. With regard to the *Place* ſome are *Sea-fiſh*, others *River-fiſh*, and others ſuch as delight in *Lakes* and *Ponds*. With reſpect to their covering, ſome are *Scaly*, ſome covered only with a *Skin*, and that either with a *ſmooth*, or *rough* one. Amongſt *Sea-fiſh* ſome are called *Littoral*, becauſe they delight in the neighbourhood of the *Shoar*, ſuch are amongſt the *Scaly Fiſhes* the *Roach*, and the *Trout*, *&c.* and of the ſmooth skin'd *Fiſhes*, the *Mackrel* and the *Eel*; others are called in Latin *Saxatiles*, becauſe they delight in *Stony Places*, as the *Gilthead*, common in the Sea of *Crete*, the *Gudgeon*, the *Hornback*, ſome paſs from the *Sea* into *Rivers*, as the *Salmon*, the *Lamprey*, *&c.*

III. *Fiſhes are propagated by Copulation.* Some have been of the opinion that *Fiſhes* were not generated by *Copulation*, but that the *Female* ſwimming before did ſcatter her *Spawn*, which the *Male* following her did impregnate, by *pouring* his *Milt* upon them. But this is a miſtake, for *Fiſhes* do *copulate*, which would be altogether in vain, in caſe the foreſaid opinion were true. Beſides how can we conceive that the *Spawn* or *Eggs* of the *Female Fiſhes*, ſhould be ſprinkled with the *Milt* of the *Males*, ſeeing that it would by mixing with the *water* loſe all its virtue. Neither can we build much upon *ARISTOTLES Authority* in this Caſe, foraſmuch as he doth not prove it by any *Experiment*. And in his *3d Book de Animal. Cap.* 7. he owns the thing to be doubtful. *Fiſhes* therefore are *generated* by *Copulation* as all other *Oviparous Animals* are: but to what purpoſe would this *Copulation* be, if the *Male* doth not by his Emiſſion render the *Eggs* of the *Female* fruitful? Beſides, it is obſerved that the *Males* abound with *Milt* at the ſame time that the *Females* abound with *Spawn* or *Eggs*, and that then is the time of their *Copulation*. And it is at the ſame time that the *Males* follow the *Females*, not that they may beſprinkle the ſcattered *Eggs*, but that by their repeated *Copulation*, they may impregnate other of the *Females Eggs* that are ready to be *Spawn'd*: as we ſee that to the ſame end a *Cock* doth often tread the *Hen*: for ſeeing that *Fiſhes*, above other *Animals*, do abound in *Eggs*, they can never all of them be impregnated by one act of *Copulation*. From this way of *Generation* we are to except the *Dolphin* and the *Whale*, which are not *Oviparous*, but bring forth *living Births*, and therefore their way of *Copulation* is different, and their *Breaſts* are filled with *Milk*, contrary to the nature of other *Fiſhes*.

IV. *Many Monſters are found amongſt Fiſhes.* Amongſt *Fiſhes* there be many that are called *Monſtrous*, as the *Hippopotamus* or the River *Horſe*, becauſe it reſembles a *Horſe*, yet not ſo much in *Figure*, as in its *Bulk*. For it hath *Ears* like a *Bear*, and a *Mouth* wider than that of a *Lion*, with very great *Eyes*, and a very ſhort *Neck*, or none at all; it hath the *Tail* of a *Swine*, with ſhort *Feet*, and a divided *Hoof* like a *Hog*. *ARISTOTLE* deſcribes this *Animal Lib.* 2. *Hiſt. Animal.* thus; The *River-horſe*, ſaith he, which *Egypt* brings forth, hath the *Mane* of a *Horſe*, a round *Hoof* like a *Pipe* or *Tube*, a flat *Snout*, and an *Anckle* like thoſe that divide the *Hoof* in two, *Teeth* ſomewhat prominent and ſticking out, the *Tail* of a *Swine*, the *Voice* of a *Horſe*, the bigneſs or bulk of an *Aſs*; the thickneſs of his *Hide* being ſuch, that they make *Hunting-ſtaffs* of it; and all the inward parts of it reſembling thoſe of an *Aſs* or *Horſe*; which is the account *PLINY* gives us from *Ariſtotle*. The *Sea-calf* is alſo accounted a *Sea-monſter*, for it differs from all other *Fiſhes* in the ſhape of its *Body*, inſomuch that *ARISTOTLE* ranks it amongſt 4 footed *Beaſts*. This Monſter hath ſhort *Arms*, without any *Elbow*; and for the reſt hath ſome reſemblance with our *Bodies*: It conſiſts of many *Bones*, and is covered with a thick *Hide*, full of dark couloured *Hairs*, drawing towards an *Aſh-colour*: the *Head* of it is but little with reſpect to its *Body*, and its *Neck* is long, which it can ſtretch out, and draw in at its pleaſure; it hath no *Ears*, but inſtead thereof only ſome open *holes*; its lower *Jaw* reſembles that of a *Wolf*, but the upper is much broader than thoſe of the ſame *Animal*; his *Noſtrils* are very like that of a *Calf*, his *Teeth* like thoſe of a *Wolf*, and his *Eyes* are of a changeable and uncertain *colour*. A *Thornback* alſo is a very deformed

and

and monſtrous *Fiſh*, but being ſo commonly known, there is no need to inſiſt upon the Deſcription thereof.

V. *The* Peripateticks *following their Maſter, deny all Reſpiration to Fiſhes.*

Foraſmuch as *Reſpiration* is ordained by *Nature* for the *Cooling* of the *Blood*, and to ſend away the *vapours* and ſmutty ſteams proceeding from the *Body*, which would otherwiſe ſtop the *Blood* from entring into the left *Ventricle* of the *Heart*, if they were not emitted out; it hath been a queſtion controverted amongſt the *Antients*, whether *Fiſhes* and other *Animals* that want *Lungs* do breath or no. This is commonly denied by the *Perepateticks* upon their *Maſters* Authority, who by no means will allow any *Reſpiration* in *Fiſhes*.

VI. *Fiſhes breathe by the drawing in, and letting out of their Breath.*

But our Modern *Philoſophers* and *Phyſicians*, tho' they cannot allow *Fiſhes* ſuch a *Reſpiration* as is performed by the Contraction and Dilatation of the *Midrif*, and *Lungs*, ſince they take for granted that *Fiſhes* (except *Whales* and *Dolphins*) have no *Lungs*, yet neither do they deny them ſuch a *Reſpiration* as conſiſts in the drawing in of *Air* or the like *Halituous Matter*, in order to the cooling of their *Blood*. *Pliny* joins with this opinion, *Lib.* 9. *Cap.* 7. *becauſe*, ſaith he, *inſtead of Lungs they have other Organs for Breathing, and inſtead of Blood ſome other Equivalent humour.* Neither do we want reaſon wherewith to back this opinion; for the end of *Reſpiration* is the cooling of the *Heart*, and the cheriſhing and refreſhing of the *Vital Spirits:* now both of theſe are neceſſary to the preſervation of the Life of *Fiſhes*. Beſides, why were *Gills* given to *Fiſhes*, but that through them the *Water*, either alone by it ſelf, or mingled with the *Air*, might be conveighed to the *Heart*, and afterwards caſt out again? But who will not be convinced that *Fiſhes* muſt take in the *Air* by *Reſpiration*, when we find that they die without it? For if *Fiſhes* be ſhut up in a *Veſſel* with a narrow *Mouth*, full of *Water*, they may be kept alive there for many *Months*, if the mouth of it be kept open, but if it be ſhut up they die immediately, which would never be if they did not ſtand in need of *Air*, or if *Water* alone were ſufficient for the cooling of their *Heart*.

VII. *The Reſpiration of Fiſhes proved by Experiment.*

And what is very obſervable herein, is that as ſoon as the *Veſſel* is ſtopt the *Fiſh* get themſelves up to the top of the *Water*, to take in ſome *Air*, which they do not do whilſt the *Veſſel* is open, but play up and down the *Veſſel*. Wherefore *RONDELETIUS* in his 4*th. Book of* Fiſhes, *Cap.* 9. ſaith, that the greateſt *Fiſhes*, and thoſe that have *Lungs* do draw in the *Air* together with the *Water*; and caſt it out again by the ſame *Pipe*, whereby they draw in their Breath: and in this manner do *Whales*, *Dolphins* and *Whirlpools* (a *Fiſh* ſo called) draw their *Breath*. Others perform this *Reſpiration* by the *Lungs*, only without the aſſiſtance of a *Pipe* to caſt out the *Water*, as *Sea Tortiſes* or *Tortles*, and thoſe of *Rivers* and *Lakes*; as alſo *Sea-Calves*, who have wide *Noſtrils*, and a very ſtrait *Windpipe*, by which means they *ſpout* out the *Water* again through their *Noſtrils*, but retain the *Air*. All other *Fiſhes* that have either open or cloſed *Gills*, do with them draw in the *Air*, and at the ſame time caſt out the Water. *Oyſters* which are covered only with a very thin *Skin*, ſeem to breath through the *Pores* thereof. And in a Word, all *Animals* living in the *Waters*, according as their *heat* is more intenſe or remiſs, or according as their *Spirits* are more or leſs copious, ſo they have a ſeveral way of *Reſpiration*.

VIII. *The Life of all Animals is preſerved by the Air.*

Neither indeed is there any *Animal* in the Univerſe, which is not preſerved by the *Air*, as is manifeſt from the *Pneumatick Engine* of Mr. *BOYL*, in which whatſoever *Animals* are put, excepting only *Oyſters* and *Crabs*, die immediately. The ſame thing is yet more evident in *Inſects*, in whoſe *Rings* 2 *Holes* are diſcernible; which when they are ſtopt with *Oil* or any other *glewy* or *clammy Liquor*, ſo that the *Air* cannot have its free entrance, the *Animal* preſently begins to languiſh, and after ſome Convulſive Motions expires.

IX. *Why a Man cannot breathe under water.*

But you will object with *ARISTOTLE*, that if the *Air* do penetrate the *Water*, and reacheth to the very heart of *Fiſhes*; why then for the ſame reaſon a *Man* may not as well fetch his *Breath* under *Water*?

I Anſwer, that the cauſe thereof is, becauſe *Man* living in the *Air*, doth continually attract it very copiouſly, whereas that portion of *Air* which is in the *Pores* of the *Water*, is very inconſiderable if compared with that which *Men* naturally take in, and therefore is not ſufficient to anſwer that end. Moreover, for want of *Air* the *Water* is drawn into the *Lungs*, and there being no way to caſt it out, becauſe of other *Water* ſtill coming in, it oppreſſeth the *Heart*, and choaks a *Man*. Whereas *Fiſhes* are furniſht with *Gills*, by the help whereof they caſt out the *Water*, nor ſuffer it to come to their inwards, but the *Air* only, whereby the heat of their *Heart* is allayed and their *Vital Spirits* preſerved.

X. *How Fiſhes ſwim.*

The *Swimming* of *Fiſhes*, doth ſomewhat reſemble the *Flying* of *Birds*: for their *Fins* are inſtead of *Wings*, as alſo their *Tail*. Theſe conſiſt of *Membranes*, joyned together by long *Fibres*, and which can be diſtended or contracted and turned every way.

XI. *What inſtruments the Fiſhes uſe to move themſelves in ſwimming.*

There are in all *Fiſhes*, *Bladders* full of *Air*, which according as they are compreſt or dilated, ſo the *Fiſhes* are poiſed on the *waters*. For it hath been obſerved that a *Fiſh*, whoſe *Airy Bladder* had been broken in the empty Recipient of the *Pneumatical Pump*, could never, during a whole Months time, that it lived in a *Fiſh-pond*, riſe to the top of the *water*, but was fain to keep at the bottom of it. According therefore as *Fiſhes* do contract or dilate the ſaid *Bladder*, ſo they encreaſe or diminiſh the bulk of their *Body*, and accordingly alſo do diminiſh or increaſe their *weight*; and by this means they can either dive to the bottom of the *water*, or mount to the top of it. Much after the ſame manner as *Glaſs Bubbles*, or *Figures* hanging in a *Glaſs Tube* full of *water* are made to go down to the bottom, or to come up to the top at pleaſure.

XII. *What uſe the Fiſhes make of their Tails.*

A *Fiſh* by moving of her *Tail* advanceth ſwiftly, and reſts when that motion ceaſeth; ſo that the ſhaking or turning of her *Tail* is the chief cauſe of her *motion*; for when ſhe ſhoots forwards directly with her *Belly*, ſhe turns the other half of her *Body* ſideways, and whilſt ſhe ſtrongly beats the *water* with her *Tail*, ſhe at the ſame time moves her body forward, much after the ſame manner as a *Boat*, which the *Oar* drives forwards, whilſt it obliquely ſtrikes the *water* that is behind it. A *Fiſhes Tail* alſo performs the uſe of a *Helm*, by turning the *Fiſhes* courſe to the Right or Left.

Thus

VIII.
The Life of all Animals is preserved by the Air.

IX.
Why a Man cannot breathe under water.

XIII.
Of Flying Fishes.

X.
How Fishes swim.

XI.
What instruments the Fishes use to move themselves in swimming.

XII.
What use the Fisher make of their Tail.

To M.r Iohn Ieffreys only Son and Heyre of Iohn Ieffreys of Llywell in Brecknock shire, and of the Citty of London Esqr, by Elizabeth his wife.

This Plate is humbly Dedicated by Richard Blome.

Figure 61. Thus by Example, the *Fiſh* A B C, that is about to move it ſelf, turns its *Tail* D F C, to the Right G, and that ſo, that whilſt the part moved B C, turns about its *Center* B, it doth not continue ſtrait, as the Ray of a *Circle*; but bends it ſelf 2 ſeveral ways towards B, *viz.* by advancing her ſide F towards the Right-ſide G, and by turning the utmoſt part of her *Tail* D to the Left, by which means the *VVater* does but little reſiſt her. Afterwards, her *Tail* turning again by the force of the *Muſcles*, it drives the *VVater* from G towards F, as an *Oar* would do: Whence it follows, that the *Fiſh* muſt advance from C to A, and then its *Tail* being again moved from C to H, as we have ſaid that it was moved from F to G; and being afterwards turned again, it drives the *VVater* from H towards C, and by this means makes the *Fiſh* advance in a ſtrait Line from C to A; by the repeating of which *motions* of her *Tail*, the Fiſh continues *ſwimming* along.

XIII. *Of Flying Fiſhes.* Amongſt *Fiſhes* there are ſome that *fly*; as the *Sea-Swallow*, and the *Sea-Hawk*, ſo called, which have *fins* joyned to their *Gills* of that length, that they reach almoſt to their *Tails*. Theſe ſometimes fly in ſuch vaſt Shoals in the *Air*, as PLINY tells us, that they encumber *Veſſels* in their Courſe, and ſometimes make them ſink. But they never fly high in the *Air*, but keep cloſe to the Surface of the *VVater*; ſo that ſome queſtion, whether the *Sea-Hawks* fly or ſwim. They continue thus hovering in the *Air* as long as their *Fins* are wet; and as ſoon as they are dry, fall down again into the *VVater*.

CHAP. XXII.

Of Inſects.

I. *Four kinds of Bloodleſs Animals.* ARISTOTLE reckons up 4 kinds of *Bloodleſs Animals*: Such as are *ſoft*, as the *Polypus* or *Pourcoutel*, the *Cuttle-fiſh*, *&c.* Such as are cover'd with a hard Shell, and difficult to be broken; as the *Crab*, *Lobſter*, *&c.* Such as are cover'd with a Shell that is *brittle* and eaſily broken; as *Cockles*, *Perwinkles*, and other ſmall *Shell Fiſhes*; and of theſe there is ſo great a variety, with reſpect to *figure* and *colour*, that they cannot all of them be reckon'd up. And, Laſtly, *Inſects*, ſo called from the Interſections and Diviſions of their *Bodies*; which alſo are ſtyled by ALBERTUS MAGNUS, *Annulata*, as conſiſting of ſeveral *Rings*.

II. *The great variety of Inſects, with relation to the place wherein they live.* The Variety of *Inſects* is very great, with reſpect to their *Food*, the *quality* of their *Bodies*, and the *Place* in which they live. As to the *Place*, *Hairy* and *Red VVorms* are generated in the *Snow*: *Fire-flies*, which ſome ſuppoſe to be *Crickets*, in the *Fire*. Which I have ſpoke of in my *Hiſtory of Nature*, in the *Part* that treats of *Animals*. In the *Sea*, the *Sea Scolopendra*, and *VVater-Flea*: In *Freſh-waters*, *Leeches*, *Horſe-Leeches*, *&c.* In the *Earth*, *Earth-VVorms*; between the *Barks of Trees*, *VVood-Lice*; in *Fig-trees*, a certain Worm called *Ceraſſes*; in the *Service-tree*, Red and Hairy *VVorms*; in *Vines*, the Worms called *Butyri*, *&c.*

III. *The difference of Inſects, with reſpect to their Parts.* As to their Parts, ſome *Inſects* have no *feet*, others have. All *VVorms* are without *feet*, as well thoſe which are generated in the *Earth*, as *Earth-VVorms*; as thoſe that breed in the *Bodies* of *Animals*, eſpecially in their *Guts*. The *VVeevil*, that breeds in *Corn*, another that is found in *Beans*, *&c.* Amongſt thoſe that have *feet*, ſome have 6; as the *Piſmire*, the ſtinking *Bug*, the *Flea* and *Louſe*: Others have 8 *feet*; as the *Scorpion* and *Spider*: Some 12; as that of *Canker-worms*, which is called the *Geometrician*, becauſe it hath 6 *feet* in the fore-part of his *Body*, and as many in the hinder-part, and raiſeth up his Back in the form of a *Bow* or *Arch*, going like one that meaſures *Land*: Some have 14 *feet*; as all other ſort of *Canker-worms*, which in the fore-part of their *Bodies* have 6 *feet*, and 8 in the hinder part.

IV. *Of the Generation of Inſects.* As to the *Generation* of *Inſects*. The general Opinion formerly hath been, that they were not produced by a true *Generation*, but deriv'd their Pedigree from the *Corruption* of *Animals*, or other things. But *Experience* hath informed us of the contrary: For if we put a piece of *Fleſh* into a *Bottle*, and then ſtop it; the Fleſh ſhut up there will never breed any *VVorms*; but if we leave the *Bottle* unſtopt, it will be full of *Worms* in leſs than 4 days, in the Summer time. We find alſo, that *Butter-flies*, after *Copulation*, do lay a vaſt number *Eggs*, whence *Canker-worms* are hatched.

V. *All Inſects proceed from Eggs.* So that we may rationally conclude, that all thoſe *Animals* which ſeem to breed of themſelves, and are found in *Cheeſe*, in *Fruits*, in *Trees*, in *Flowers*, and in *Men*, are the product either of *Eggs*, or ſuch like *Seed*, left by other *Animals*. The production and proceſs of which, may be fully illuſtrated by the *Generation* of a *Canker-worm*. For *Canker-worms*, as all other *Worms*, are generated from a *Seed*, or from the *Eggs* of *Flies* or *Butter-flies*, which by the *heat* of the *Sun* are hatched into *Worms*; which, after they have changed their *Skins* ſeveral times, turn to *Canker-worms*, and then to *Aurelia's* or *Bodies* without motion, cover'd with a *Shell*, and in which no diſtinction of *Parts* appears; and theſe again are turned into *Butter-flies*, or *Flies*. For it ſometimes happens, that from the ſame *Canker-worms* and *Worms*, *Aurelia's* do proceed; whereof ſome are turned into many *Flies*, and others into ſingle *Butter-flies*. Out of a *Worm* therefore a *Canker-worm* is formed; becauſe, as a *Plant* doth not immediately bring forth *branches*, *flowers*, *leaves* and *fruit*, but by degrees, and each of theſe in their due Seaſon; ſo theſe *Worms*, by degrees, arrive to a further meaſure of perfection. For certain it is, that theſe *Worms* do often change their *Skins*. A *Canker-worm* therefore is changed into an *Aurelia*; becauſe the Trunk of its *Body* being ſwoln, and its *Members* almoſt formed, it ſo happens that all his Coats and Coverings begin to grow dry, and fall away of themſelves; as *Flowers* fall from *Trees*, and *Feathers* from *Birds*; which when the *Aurelia* perceives, it either wraps it ſelf in a Leaf, or with a glutinous Liquor proceeding out of its own *Body*, it moſt artificially weaves a ſtrong Covering for her ſelf; where it continues ſhut up, as in an *Egg*, till it receive new *Members*, *Head* and *Wings*, and ſo become turned to a *Butter-fly*.

VI. *Flies and other Inſects, proceed from Worms.* And the ſame is to be ſaid of all other *Inſects*, that have *Wings*. For *Flies* proceeding from *Eggs* or *Seeds*, by ſome Changes as have now been mentioned, do attain to the Perfection of their Nature; for firſt they are *Worms*, then they turn to *Aurelia's*, and out of them *Flies* do proceed.

ceed. For as a *Canker-worm* is to a *Butter-fly*, the ſame reſpect or relation a *Worm* hath to a *Fly*. And ſo likewiſe *Lice*, *Fleas*, *Bugs*, and other ſuch like *Inſects*, are generated of *Eggs* or *Nits*, or of other *Inſects* already produced. For all thoſe *Animals* which are commonly ſaid to be generated out of *putrid Matter*, that is the Corruption of other things, are produced by *Copulation*; as we ſee that *Flies* do Copulate when *Auguſt* is paſt, and thereupon they bring forth not *Worms*, but *Eggs*, which are found in great abundance upon the *Leaves of Trees*, in the appearance of a *black ſmutty Matter*; which afterwards, by the *Heat* of the *Sun* are hatched into *Worms*, but ſuch as are immoveable, and anſwering to the *Aurelia's* of the *Canker-worms*, which afterwards are changed into *Flies*.

VII. *How Canker-Worms become changed into Butter-flies.*

This *Metamorphoſis* is not ſo difficult to conceive, if we ſuppoſe that thoſe Parts which ſeem to be produc'd anew, are only made viſible, as having before been hid. For when *Canker-worms*, by Example, become *Butter-flies*, it is eaſie to conceive, that the *wings* and *feet* they get, and which makes them appear to have been changed into new kinds of *Things*, are not newly produc'd Parts, by obtaining of a new *form*, which they had not before; but that theſe Parts were indeed before, and only wanted a ſufficient Magnitude to render them *viſible*. After the ſame manner as it happens to *Plants*, where the *flowers* and *fruits* do not unfold themſelves, but by degrees, and ſome time after the *Leaves*; tho' all theſe Parts be at once actually together in the *Plant*, before they appear to be there. *Inſects* therefore, as well as other *Animals*, are generated by the Coition of *Male* and *Female*; which latter lays *Eggs*, out of which afterwards their Young are hatched by the *heat* of the *Sun*.

VIII. *How the Eggs of Inſects are preſerved in the Winter Seaſon.*

But here it may be demanded, How theſe *Eggs*, whence we have ſaid that *Canker-worms* and *Flies* are hatched, are preſerved all the *Winter* over, ſo as that the next *Year* they may produce *Animals*. ALDROVANDUS, in his Treatiſe *De Inſectis*, ſuppoſeth that thoſe *Eggs* only are preſerved, which are in thoſe Leaves that are hid in the Cavities of the *Barks* of *Trees*, where they cannot ſuffer any damage from the Injuries of the *Air* or *Weather*. Thus I my ſelf, *ſaith he*, have obſerved *Eggs* faſtned to the hinder part of *Fig-Leaves*, whence, towards the End of *Auguſt*, little *Canker-worms* did proceed. They were wrapt up in a thin *Downy ſubſtance*, to preſerve them from being hurt by the *Ambient body*; which *Canker-worms* afterwards falling down, were not daſh'd againſt the Ground, but continued hanging in the *Air*, like *Spiders*, by a very fine *Thread*. When they lay their *Eggs* on the Under-ſide of *Leaves*, they do ſo fold the ſaid *Leaves* that no *Rain* can hurt them, making as it were a Covert over them. I have alſo twice taken notice, that a *Canker-worm*, which I found amongſt *Cabbage-Leaves*, did firſt lay *yellow Eggs*, wrapt up in a thin *Downy matter*; which, after ſhe had laid them, became changed into an *Aurelia* of the ſame Colour, as ſhe had before when yet a *Canker-worm*, *viz. yellow*, *green* and *black*; and, which ſeem'd ſtrange to me, afterwards *flying Animals* proceeded from theſe *Eggs*, ſo very ſmall, that they could ſcarcely be diſcerned by the *Eye*; ſuch as are commonly found in the *Bladders* that are on the *Leaves* of the *Elm-tree*. *So far he.* Tho' there be ſome *Country-men* that tell us, That theſe *Eggs* are not only kept between the *Barks* of *Trees*, but that many *Leaves* fill'd with the *Eggs* of *Butter-flies*, are many times found hid in the *Earth*, where they are preſerved all the *Winter*, till by the *heat* of the *Sun*, at the return of *Spring*, they be hatched into *Inſects*.

CHAP. XXIII.

Of the Death and Deſtruction of Animals.

I. *Of three kinds of Death.*

AS in the *Firſt Chapter of this Part* we reduc'd the Notion of *Life* to 3 Heads; ſo here, that we may underſtand how *Animals* may be ſaid either to *dye* or *periſh*, 3 ſorts of *death* or dying are to be diſtinguiſh'd. Firſt, There is a *Death* of *Simple Annihilation*, which is oppos'd to the *Life* of *Simple Exiſtence*: Secondly, *Ceſſation from Operation*, which is the *Death* that is oppos'd to the *Life* of *Actuous Exiſtence*: And, Laſtly, the *Separation*, or *Diſſolution of one part from the other*, which is oppos'd to the *Life* of *Exiſtence* with another. By the *firſt* manner of *Death*, thoſe things *dye*, which by ceaſing to *exiſt* altogether, fall into nothing: Things *dye* the *ſecond* kind of *Death*, when they ceaſe to *act*: And the *third* way, when their Parts are ſeparated, and *exiſt* diſtinctly from one another. But foraſmuch as no *Subſtance* can be annihilated, it remains only for us to enquire, how *Animals* come to ceaſe from all Operation, and how the connection of their Parts comes to be diſſolved.

II. *The Death and Periſhing of Animals is deſigned by Nature, as well as their Generation.*

But before I come to Treat of theſe, I ſhall firſt lay down this Truth, That *Death* is as much the intention and deſign of *Nature*, as *Life* is. For who will ſay, that *Corruption* is leſs Natural, than *Generation*? For tho' nothing ſeems to *dye* without reluctance, and ſome force put upon it; yet is not *Corruption* therefore to be accounted leſs *Natural* or diſagreeing with the *Laws* of *Nature*. For tho' *Corruption* be contrary to particular Nature, as procuring its *Deſtruction*; yet is it very conſentaneous to *Univerſal Nature*, which never undertakes the *Generation* of any thing, without the fore-going *Corruption* of another, as not being able to *create*, or to *produce* a thing out of *Nothing*. Wherefore ſeeing, that the Beauty and Perfection of the *World* conſiſts in Variety; and that it is much more for the Dignity of the *World*, that many things in proceſs of time ſhould appear and act their Parts on this great *Theatre*, than to repreſent always one and the ſame *Face* of things: The *Divine Wiſdom* hath ſo order'd it, that Old things ſhould make way for New ones; and that thoſe things, which for ſome time have acted their Parts on the *Stage* of the *World*, ſhould withdraw to make room for others. But if any one ſhall think it a hard caſe for him to leave this *World*, let him conſider, that he himſelf could never have enter'd this *World*, but by others making room for him: For if all our Anceſtors had been *Immortal*, they would have been increaſed to that number, that there would have been no place left for their Poſterity.

Having

III. *When and how Death happens to Animals.* Having ſaid thus much to comfort us, and make the ſtate of our *Mortality* more tolerable; we now aſſert that *Death* happens to *Animals* by the extinguiſhing of the *Fire*, that is in their *Hearts*. For in the *Hearts* of all *Animals*, as long as they are *alive*, there is a kind of *Continual Heat*, which we before call'd a kind of *Fire* that is *hot* without *ſhining*, and which *Phyſicians* do own to be the *Bodily Principle* of all *motion* in the Members of *Animals*. And therefore no wonder, if this being once extinct, *Life*, *Senſe* and *Motion* be likewiſe deſtroyed.

IV. *How this Heat comes to be weakned in the Body of Animals.* For tho' this *Native Heat* be ſtrong and efficacious at the beginning, yet in the proceſs of Age it loſeth ſtrength, and grows weaker and weaker; ſo that *Animals*, after they are come to their full growth, are at a ſtand, and ſoon after their ſtrength decays; and at laſt, by the defect of this *Heat* they *dye*; as the *flame* of a *Wick*, for want of *Oil* is extinguiſh'd. But yet there is a difference betwixt the *flame* of a *Lamp*, and the *Life* of *Animals*; becauſe the former is continued, as long as it is ſupplied with *Oil*: But the *Life* of *Animals* cannot be maintained by perpetual *Aliment*, becauſe *Animals* dye not for want of *Aliment*; but becauſe their *Heat* grows ſo weak, that it can no longer change the *Food* into the Subſtance of the *Body*. And therefore *Phyſicians* tell us, that the *Heat* which Nature hath afforded us, for the Maintenance and Support of our *Bodies*, doth conſpire their deſtruction. For tho' it preſerves us, foraſmuch as by feeding upon *Moiſture*, it affords ſtrength and vigour to our *Members*; yet at the ſame time it alſo lays the foundation of our Deſtruction, whilſt by continual conſuming of our *Moiſture* it ſelf becomes debilitated, without reſtoring, as much as it doth conſume: And accordingly it follows, that when the *Moiſture* is conſumed, the *Body* muſt conſume and waſte likewiſe, and the *Heat* it ſelf be extinguiſh'd.

V. *Why the utmoſt parts of the Body firſt grow cold in thoſe that are ready to dye.* Now that *Death* proceeds from the decay of *Heat*, daily Experience teacheth us in Dying perſons: For we find that the Extream parts of their *Body* firſt begins to grow *cold*, till at laſt their *Breaſt* and *Heart* it ſelf be deprived of it. For ſince the *Heat* which is diſperſt through the whole *Body*, proceeds from the *Arteries*, inaſmuch as by thinning the *Blood* that is in them, it generates thoſe *Spirits* which communicate *Motion* to all the Parts of *Man*'s *Body*; it muſt of neceſſity follow, that when the *motion* of the *Arteries* and *Heart* grows weak and languiſhing, this Weakneſs muſt firſt affect the *Capillary Veins*, as being both ſmall and weak, and at the greateſt diſtance from the *Heart*, the Fountain of *Heat*.

VI. *An Objection from the motion of Animals, after their Heart is taken out their Bodies.* It may be you will Object here, That ſome *Animals*, after that their *Heart* hath been taken out of their *Bodies*, have notwithſtanding performed the *functions* of *Life*. ARISTOTLE alledgeth the Example of a *Tortoiſe*, which when his *Heart* is taken out, doth nevertheleſs walk about, though be be but ſmall, and of a weak and ſlow *Body*. Some *Hiſtorians* alſo make mention of ſome perſons, who have ſpoke after that their *Heart* hath been pluck'd out of ther *Bodies*. Now, whence could theſe *Actions* or *Words* proceed, if the *Heart*, by its *heat*, were the ſole *Principle* of all *Bodily motion*, and if it were the firſt thing living, and the laſt that *dies*?

To which I Anſwer, That the *Actions* performed by *Animals*, after they are deprived of their *Heart*, are to be attributed to an *Influence* derived from thence; inaſmuch as by the *Arterial Blood* convey'd to the *Brain*, the *Spirits* for a ſhort time continue their begun *motion*, and by entring the *Nerves*, produce a *motion* in the *Tongue*, or other Parts of the *Body*. Thus we find that *Inſects*, after they have been cut to pieces, do for a long while continue their *motion*, by reaſon of the ſtrength and vigour of their *Animal Spirits*, which cannot ſo ſoon exhale out of the Joynts of that Expanſion, which is in them inſtead of a *Back-bone*, and wherein the ſaid *Spirits* are contained. And as to that which was added, that the *Heart* is the firſt thing that *lives*, it is to be noted, that this is not to be underſtood of the time in which the *Birth lives*, ſhut up in the *Mothers Womb*; but after it is come forth from the ſame. For it is manifeſt, that the *Birth* in the *Womb*, doth not ſo much live by a Life of its own, as by that of its *Mother*; and that its *Arteries* do not beat from the *motion* of its own *Heart*, but by that of its *Mother*. Wherefore tho' the *Heart* be not the *Principle* of all *motions*, that are performed in the *Body* before the Birth; yet is it the *Principle* of all thoſe that are exerted afterwards.

VII. *The Cauſe of this Motion.*

VIII. *By what means Men that have been drowned, are reſtored to Life.* The *Natural Heat* therefore *laſt* forſakes the *Heart*, whether in a *Natural* or *Violent Death*: For being the chief *Principle* of all *Corporal motions*, it is more ſtrong and vigorous there, as in its Fountain, and makes the greateſt Reſiſtance againſt any Force put upon it. Thus one that hath been *Drowned*, if he be timely taken out of the *Water*, and laid with his *Head* hanging downwards, that by the voiding of the *Water* out of his *Mouth*, his *Midriff* may no longer be clogg'd by the diſtenſion of his *Stomack* from the great quantity of *Water* he hath taken down, and that by this means his *Breaſt* and *Wind-pipe*, being freed from that which ſtopt and oppreſt them, be reſtor'd to their former freedom, the Perſon returns to life again; becauſe there was ſtill ſome Force remaining in the *Heart*, whereby it was able to recommence its former pulſation. In like manner, a Perſon that is ſtarved with *Cold*, being timely reſtor'd to warmth, Recovers again; becauſe the *Vapours*, that were congealed in his *Breaſt*, begin to be diſſolved and diſcuſt by the inward *Heat*, which was not yet wholly extinct, being aſſiſted by the outward.

IX. *The difference between a Natural and a violent Death.* Wherefore this is the only difference that is between a *Natural* and a *Violent Death*; as by *Hanging*, *Beheading*, *&c.* that a *Violent Death* is performed in a moment, or a very ſhort time: Whereas a *Natural Death* comes on by degrees, and by ſlow advances, diſſolves the Tye that is between the Parts: But in both of them, the *Heat* and *Fire* in the *Heart* is alike extinguiſh'd, and takes its flight into the *Æthereal Air*, as the *Ancients* were wont to expreſs it. Accordingly SENECA, in his *66th Epiſtle*, ſaith; *The Death of all Perſons is alike; tho' the ways by which it makes its approaches be different, yet it ends and terminates in one and the ſame thing. No Death is more or leſs than other; for it hath one and the ſame meaſure and manner in all, that is, the termination or putting an end to Life.*

The

The Eighth Part
OF THE
INSTITUTION
OF
PHILOSOPHY.
OF
MAN,
CONSIDER'D WITH
Relation to his Body.

CHAP. I.
The Definition of MAN.

I. *The wonderful Composition and Structure of Man.*

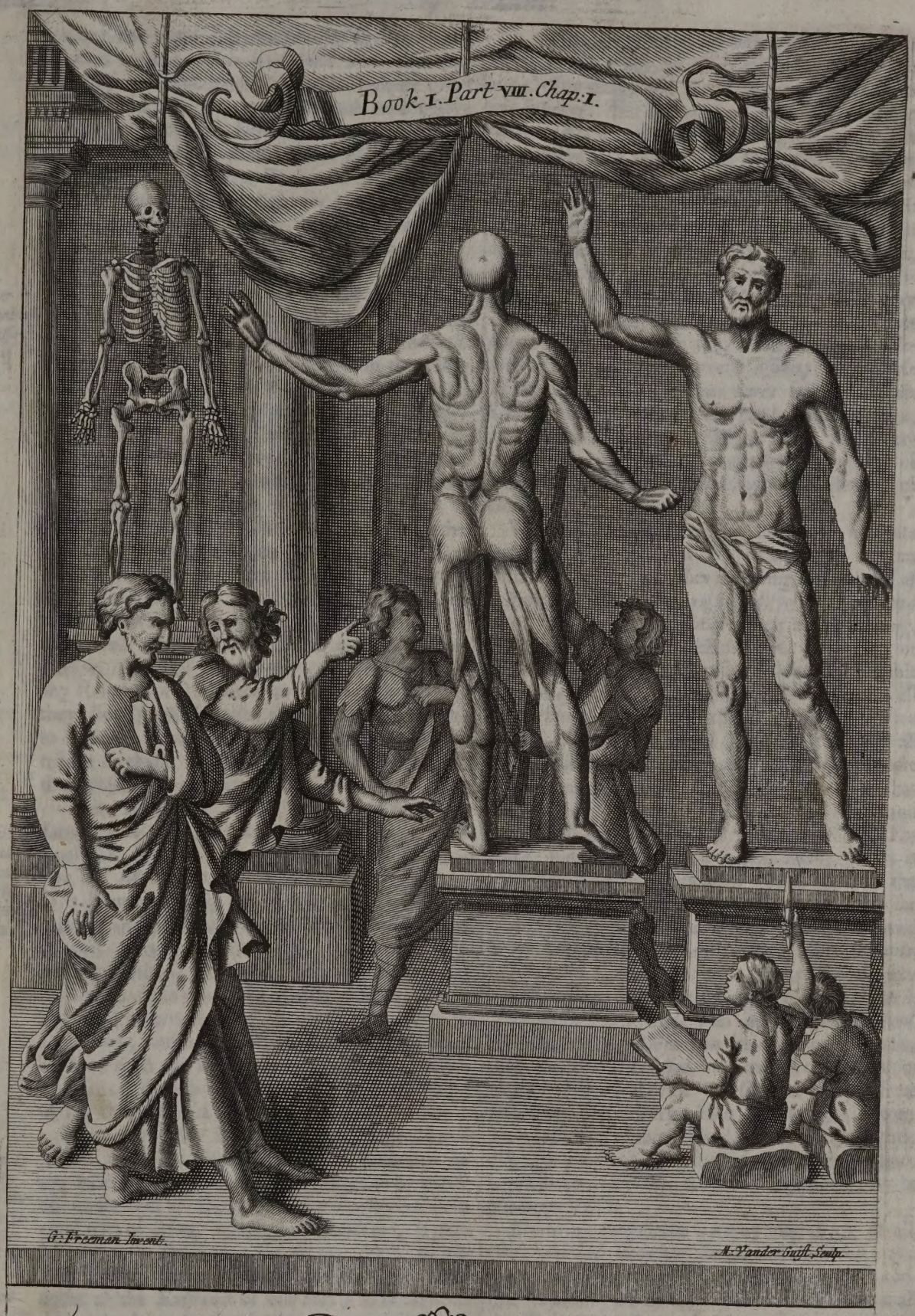
WE are now come to MAN, the most Noble of all *Living Creatures*, besides whom the *Philosophers* do not esteem any thing Great that is in the *World*; as containing in himself, whatsoever is in the *Universe*; and therefore is commonly call'd, the *Compendium* or *Abridgment* of the whole *VVorld*, and the most *VVonderful* of all *VVonderful things*, as PLATO styles him. It admits a Query, Whether he may not be look'd upon as a *Prodigy* amongst all other *Living Creatures*, as consisting of such different *Parts*; and more especially for the great Disparity that is between the *Soul* and his *Body*: So that it would scarcely be a greater Wonder, if an *Angel* should be joyned to a *Beast* or *Light* make an Alliance with *Darkness*. And therefore FICINUS, upon *Plato Dialog.* 1. *de Legibus* speaks thus: *And because he had said, that this one Animal was composed of such different things, he not without reason subjoyns, that* Man *is a Miracle* or *VVonder amongst all other Animals; herein imitating* Mercurius Trismegistus, *who calls Man, a Great VVonder, &c. But, to pass by the rest, why is Man such a VVonder? Because foraſmuch as he is Divine, it is a wonder that he should be affected with Mortal things; and being Mortal, it is as great a wonder, that he should be taken with Divine things.*

II. *Whether or no the* Peripateticks *do rightly define Man.*

Wherefore it hath always been look'd upon by *Philosophers*, to be a difficult thing to define *Man* aright, and to assign those *Terms* that might explain the Connexion of such different things, and exhibit a clear *Image* or *Idea* of him to the *Understanding*. The PERIPATETICKS, who conceit themselves to know the Nature of all Things, define MAN to be a *Rational Animal*, making *Animal* the *Genus* of *Man*, and *Rational* his *Difference*; whereby he is distinguish'd from other *Animals*. But to speak the Truth, this doth not seem to be the true *Definition* of *Man*, if we will give heed to the Rules of a *Right Definition*; the chief whereof is this, that it be *Clear and Evident*. Now it is manifest, that the word *Animal*, which they thrust into the *Definition* of *Man*, is obscure, and therefore cannot in the least contribute to the clear perception of him. For it is not manifest what the word *Animal* (which they make the neareſt *Genus*) doth signifie, without reducing it to the more remote *Genera* of a *Body*, a *Living* and an *Animated Creature*: But now, the higher we climb in the *Prædicamental Table*, the more obscure Notions we shall meet with; and therefore if the *Prædicats* of *Animal* be obscure, how will they be proper to explain and illustrate the *Nature* of *Man*?

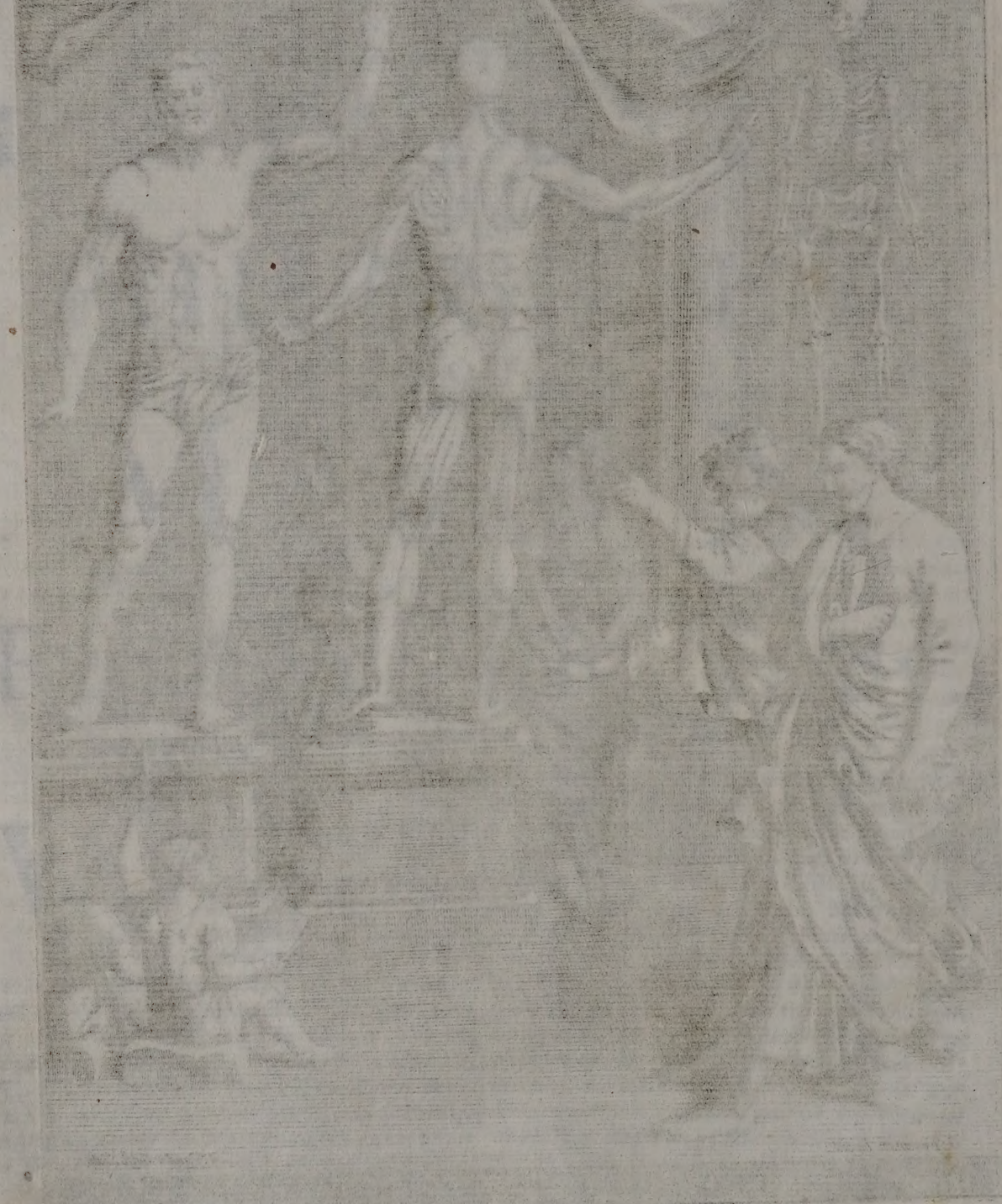
III. *The word* Animal, *cannot be an Ingredient of the definition of Man.*

Again, if we carefully examine what *Man*, and what an *Animal* is, we shall find, after a due ballancing of the Notion of them both, that we do more easily understand what *Man* is, than what an *Animal* is; and that we have a more clear Conception of *Man*, than of an *Animal*. Neither can



To Ralph Macro of Clapton in the
Parish of Hackney in the County of
Midelesex, D.r in Phisick.

This Plate is humbly Dedicated by Rich: Blome



can any one mend this *matter*, by saying that an *Animal* is that which is *endued with Life and Senſe*, ſince the notion of *Life* and *Senſe* are every whit as obſcure, yea more difficult to conceive. Wherefore ſeeing no *Definition* is to be admitted that is more obſcure than the thing *defined*, and that this *Definition* of a *Reaſonable Animal* doth not afford any ſufficient light for the underſtanding of the *Nature* of *Man*, the ſame is to be rejected, and to be left in its own darkneſs.

IV. *Neither is reaſonable the difference of Man.*

Beſides, the word *Reaſonable*, which is the other part of the *Definition*, or the Difference, is ambiguous; for by it muſt be either underſtood, that which is endued with *knowledge*; and then the Difference will agree and coincide with the *Genus*, foraſmuch as according to the *PERIPATETICKS* ſome *Brutes*, at leaſt, are endued with *Knowledge*, and are not meer *Engines* as we take them to be. Or elſe by the word *Reaſonable* is to be underſtood *Diſcourſe*, *Knowledge*, as moſt of them hold, and ſo the difference of *Man* will be taken from an inferiour *Attribute*; foraſmuch as *Man* the further he attains to perfection, the leſs he makes uſe of *Ratiocination* or diſcurſive *knowledge*; and *Wiſemen*, who are nearer to the nature of *Angels*, do more underſtand things without Diſcourſe, than others do. Or laſtly it imports a *ſimple apprehenſion*, whereby things are conceived, without any Relation or Reference to others, which ſince they allow to *Beaſts* alſo, they will never be able to explain, what kind of *knowledge* it is they attribute to them, and how it is diſtinguiſhable from that which is peculiar to *Man*.

V. *A Rational Animal doth not perfectly explain the Nature of Man.*

This *Definition* alſo is contrary to other *Laws* of a true and Rightful *Definition*, in as much as it doth not perfectly unfold the *Nature* of *Man*. For ſeeing *Man* is compounded of 2 Parts extreamly different, *viz.* of a *Soul* and a *Body*, and that there is not the like cunjunction of *parts* to be met with again in the whole *Univerſe* of things, it appears very plain that the *Eſſence* of *Man* cannot be exactly defined, except this moſt obſervable compoſition be expreſt in his *Definition*; and foraſmuch as that of a *Reaſonable Animal* doth not include any ſuch thing, it is evident that it doth but imperfectly declare the nature of the thing defin'd.

VI. *A Man is wrongly placed under the remote Genus of a Body.*

Moreover *Man* in the foreſaid *Definition* is placed under the General *Head*, or notion of *Body*, when with better reaſon he ought to be rancked under that of *Spirit* (for the *Soul* is the *Principal* part of *Man*, and if well conſidered, is more known than the *Body*; for we may doubt of the *Exiſtence* of *Corporeal Beings*, whereas we cannot doubt of the *Exiſtence* of our *Soul*) as in all other things the denomination is always wont to be made from the more noble part; and if by evil cuſtom, and the prejudices of our *Infancy* we have taken our *Body* to be our beſt and moſt noble Part, *Philoſophy* ought to have corrected this miſtake, and not to have cheriſht and ſtrengthned it.

VII. *Why in defining of man, we ought to have more regard to his Soul than to his Body.*

But you'l ſay that *Philoſophers* have thought good to define *Man*, rather by his more ignoble *Genus*, *viz. Body*, than by that of *Spirit*, becauſe *Man*, as to his *external parts* and *appearance*, is much more like a *Beaſt* than an *Angel*, and that therefore it was more proper he ſhould be ranged under the meaner *Genus* of *Body*, than under that more *ſublime* of *Angels*.

I Anſwer, that this is no better than a frivolous reply, as being not at all founded upon *Reaſon*, but *Cuſtom* only, and the *prejudices* ſuckt in from our *Infancy*. For the *queſtion* here is not about what *objects* our thoughts are moſt imployed, but about what they ought to be employed; and that theſe are thoſe things that are endued with *underſtanding* no *Man* will deny, theſe being much more excellent than *corporeal things*, and to which our *mind*, becauſe of the affinity it hath with them, is moſt inclined, ſhe herſelf being of an *Intelligent* or *Thinking Nature*. Now the reaſon why *Men* chiefly addict themſelves to *Corporeal* and *ſenſible Things*, is becauſe they think that their *Nature* or *Eſſence*, hath a greater *affinity* with *Viſible Things* than with thoſe that never fall under their *Senſes*, and can only be reached by their *thoughts*, or intellectual faculty. Which Error ought certainly to be corrected by thoſe who may glory of their being made after the Image and likeneſs of God.

VIII. *The true Definition of Man.*

We muſt therefore look out for a more accurate *Definition* of *Man*, and ſuch a one, if I be not miſtaken this is: *A Man is a thing compounded of a Finite Mind, and a rightly diſpoſed or framed Body.* For ſeeing that *Man* is not a ſimple *thing*, but compoſed of both kinds, *viz.* of a *Soul* or *Mind* and *Body*, it is neceſſary that this notable *compoſition* which diſtinguiſheth *Man* from all other *things*, ſhould be expreſt in the *Definition* by this word *Compounded*; and by this means all the conditions of a good and lawful *Definition* are ſecured and preſerved; the *Firſt* whereof is that it expreſs and declare the *Nature* of the *thing*, and the ſeveral *parts* whereof it is compounded. For there is nothing to be found in *Man*, which is not expreſt in this *Definition*. *Secondly*, that the *Genus* and *Difference* be rightly aſſigned; for that *Man* conſiſts of a well diſpoſed or framed *Body*, this he hath in common with other *Animals*, and that he is endued with a *Finite Mind*, that is ſuch an one as is not altogether perfect, he is diſtinguiſht from *God*, who is the *Infinite Mind*. *Thirdly*, that the *Definition* be not more extenſive than the thing defined, nor more contracted or narrow, but equal with it; for it is manifeſt from *Induction* that every *Man* whatſoever is compounded of a *Finite Mind*, and a *Body* rightly diſpoſed; ſo that of whatſoever the thing defined is prædicated, of the ſame the *Definition* may be prædicated alſo.

IX. *What may be inferred or gathered from the Definition.*

From this *Definition* we may infer *Firſt* of all, that *Soul* and *Body* are the parts of a *Man*; as a part is taken for that, whereof any *thing* doth conſiſt. *Secondly*, that the *Union* of the *Soul* with the *Body*, is the *Form* of *Man*; ſince whereſoever that *union* is, the compound is likewiſe, as where it is not, the compound is not, *viz. Man*. Which *Union* of the *Soul* with a *Human Body*, doth conſiſt in the mutual *Action* of the *Soul* and *Body* upon each other, as ſhall be ſhewed in the following Part.

X. *What a rightly diſpoſed Body is.*

And whereas the other part of this *Definition* is *a Body rightly diſpoſed*, we are to take notice that this *diſpoſition* doth conſiſt in ſuch a *Modification*, whereby the body is fitted for an *intimate union* with a *Human Soul*. Wherefore every *Portion* of *Matter*, that is ſo modified, whether it be *Organical* or *Inorganical*, may properly be called a

Human Body, ſince the *Eſſence* of *Man* wholly conſiſts in the *Union* of his *Soul* with his *Body*, and that it will be his Body as ſoon as it is united to him. Neither is it any whit clear or evident, that *Organs* are of abſolute neceſſity to this *Union*; for I can ſee no reaſon why an *Inorganical Body* may not be ſo diſpoſed, as to be fit to receive a *Soul* for its *Form*. Neither can a *Man*, if we have reſpect to his bare *Eſſence* only, be ſaid to be imperfect, becauſe he is deſtitute of *Organs*, foraſmuch as a *Man* that hath loſt both his *Arms* and *Legs*, doth not ceaſe to be a perfect *Man* for all that, as being no leſs a *Man*, than he who enjoys all his *Members*, becauſe the perfection of a *Man* as ſuch, conſiſts in the *union* of his two *Eſſential Parts*, *viz.* of *Soul* and *Body*. And as his *Soul* is ſaid to be perfect, becauſe it hath that diſpoſition which on its part is required for its union with the *Body*; ſo that *Body*, whatſoever it be, provided it only have ſuch a diſpoſition that it may be united with a *Soul*, is to be called a perfect *Human Body*. But foraſmuch as we here conſider *Mans Body* in its *Natural State*, we ſhall deſcribe it here as it is *Organical*, and conſiſting of all its *Parts*.

CHAP. II.

A Deſcription of the External Parts of Mans Body.

I. *It is ſufficient for a young Scholar in Philoſophy to know the more principal parts of Mans Body.*

VERY wonderful is the *Structure* of *Mans Body*, if we conſider all its *Parts*, and the uſe or end for which they were framed: but becauſe it would require too much time and pains, to give here a particular account of them all; and becauſe that belongs rather to a *Phyſician* than a *Philoſopher*, I ſhall only touch at the more *Principal Parts*, paſſing by thoſe which would rather confound firſt beginners than inform them.

II. *How many Similar parts there be in the Body of Man.*

For the better underſtanding of them, we muſt obſerve that the *parts* which conſtitute the *Body* of *Man*, are either *Similar Parts*, or *Diſſimilar*. *Similar* are thoſe *whoſe ſubſtance is the ſame, and alike throughout*: or which may be divided into *Parts* of the ſame nature and Denomination; and of theſe 11 are reckoned up by *Phyſicians*, *viz.* *Bones*, known by their great hardneſs and firmneſs; *Griſtles*, which are the next in ſolidity and firmneſs to that of *Bones*, and of which the *Ear* conſiſts. *Tendons*, which are the ends or extremities of the *Muſcles*; *Ligaments*, which approach to the nature of *Tendons*, and ſerve to join 2 ſolid parts together, *viz.* *Bones* to *Bones*. *Fibres*, which are as it were the *Woof* of the other parts. *Membrans*, which are thin and broad *ſubſtances*, ſerving for a covering to ſeveral *parts*: ſuch as are the *Membran* or *Skin that covers the Ribs*, the *Bladder*, the *Stomach*. *Arteries*, which conveigh the *Vital Blood* from the *Heart* to all the parts of the *Body*. The *Veins* which conveigh the *Blood* back again from the parts to the *Heart*. The *Nerves* or *Sinews* which carry the *Animal Spirits* from the *Brain* and the *Marrow* of the *Back Bone* to all *parts*; and the *Fleſh* and the *Skin*. To which may be referred alſo the *Fat*, *Nails* and *Hair*, as being parts compleating the whole, and of a ſimilar nature.

III. *How many Diſſimilar*

Diſſimilar Parts are ſuch as are made up of ſeveral *Similar Parts*; or which may be divided into *Diſſimilar Particles*, as a *Hand*, *Foot* which may be divided into *Skin*, *Fleſh*, *Bones*, *Veins*, *Arteries and Nerves* which are of a different Nature and Denomination. And ſuch are the *Head*, *Neck*, *Breaſt*, both the *Arms*, *Legs*, *&c.* *Parts there be in Mans Body.*

IV. *The Head.*

The firſt and Principal part of the *Human Body* is the *Head*, which *contains the Organs of Senſe and Motion, and is the Houſe or Abode of the Soul it ſelf.* It is round or *Sphærical*, but ſomewhat compreſt or *flatted*, and longiſh: and for its better ſecurity, is all cover'd with *Bones*. And is placed in the higheſt part of the *Body*, according to *GALEN*, for the *Eyes* ſake, which are placed there as in a *Watch* Tower to take a proſpect of all *objects* round about it.

V. *The Parts of the Head.*

The *Head* is divided into the *Hairy* part or Scalp, and that *without Hair*, called the *Face*. The *Forepart* of the Hairy *Scalp*, from the *Forehead* to the *Sutura Coronalis*, is called *Sinciput*, that is, the *Forepart* of the *Head*; and that which reacheth from the *Sutura Lambdoidea* to the firſt *Joint* of the *Neck*, is called *Occiput*, or the *Hinder Part* of the *Head*; the middle and *Gibbous* part between both theſe, is called *Vertex* or the *Crown* of the *Head*. The part without *Hair*, that is, the *Face*, hath alſo its ſeveral parts, the *Forehead*, or ſuperior part, which bears the Signs of the Mind; and the Inferiour in which are the *Organs* of the *Senſes*, as the *Eyes*, *Noſtrils*, *Ears* and *Mouth* which hides the *Tongue*.

VI. *The Membrans inwrapping the Skull.*

There be two outward *Membrans* that encompaſs the *Skull*, the *Pericranium* or *Skin* ſo called from its going *about the Skull*, which is a ſoft and thin *Membran*; and the *Perioſtium*, which is a moſt thin *nervous Membran*, ſo cloſely joined to the *Pericranium*; that they ſeem only to conſtitute one *Membran*. To which are conjoyned the *Inward Membrans* that infold the *Brain*, which are likewiſe 2, *viz.* a *thin one*, that immediately covers the *Brain*, and is called *Pia Mater*, and a *thick one*, which is called *Dura Mater*. They are commonly called *Meninges*, and by the *Arabian Phyſicians*, *Matres* or *Mothers*, becauſe they ſuppoſed all the *Membrans* of the *Body* derived and propagated from theſe.

VII. *How the Blood comes to them.*

To theſe *Membrans* the *Vital Blood* is conveighed by the outward Branch of the *Arteris* called *Carotides*, and that which is left after the Nouriſhing of their parts, is by ſmall *Veins* ſent back to the *External Jugulars*. Some believe that theſe *Arteries*, paſſing through the little *holes* of the *Skull*, do penetrate and paſs into the great *Boſom* or cavity of the *Dura Mater*: tho' this doth not ſeem probable, ſince they tend only to the *Diploïs*, and in it do vaniſh or diſappear.

VIII. *What the Neck is.*

The *Neck* is that part of the *Body* which is between the *Breaſt* and the *Face*, and ſupports the *Head*, being called *Collum*, *à Colendo*. Becauſe it is commonly much adorned. It is ſomewhat longiſh, to aſſiſt the *tuning* of the *Voice*. Accordingly thoſe *Animals* that utter no *Voice*, as *Fiſhes*, want a *Neck*; and thoſe that have a ſtrong *voice*, have the longer *Necks*, as *Cranes*, *Geeſe*, *&c.* The hind part of the *Neck* is called *Cervix*; and the forepart *Guttur* or the *Throat*. The *Neck* conſiſts of 7 *Joints*, which are the upper part of the *Spine*. In the forepart of it are 2 great *Pipes*, whereof the one is called the *Wind-Pipe* or *Rough Artery*, becauſe of its unequal *Griſtly Rings*, and ſerves to conveigh the *Air* to the *Lungs*, and from thence

out

out of the *Body*. The other inward *Pipe* is the *Gullet*, by which the *Meat* and *Drink* is conveyed from the *Mouth* to the *Stomach*.

IX. *The Breast.* Next to the *Neck*, the *Breast* begins, which is that part of the *Body* which contains the *Heart*, *Lungs* and *Vital parts*: Its hind-part comprehends, besides the *Shoulder-blades*, the *Back*, and 12 Joints of the *Spine*; from whence 7 *Ribs* do proceed, having their Ends cloathed or cover'd with *Gristles*, which are called the true or perfect *Ribs*; because they Circle-wise compass the hollow of the *Breast*, reaching to the *Grisly* or *Spongy Bone* called *Sternum*, and ending downwards in the *Gristle* that resembles the *figure* of a *Sword*. In the Middle of the *Breast* are 2 *Dugs* or *Paps*, on each side one; situated there, First, in order to their being near the *Heart*, to receive *heat* from thence: Secondly, for Comlineſs sake: Thirdly, for the more convenient Suckling of *Children*. They are 2 in number; not for to Suckle *Twins*, as some will have it, but to the end that if one of them should come to any hurt, the other might supply the place of it, and perform the Function alone.

X. *The Dugs consist of two parts.* The *Dug* is divided into the *Nipple*, and the *Pap* it self. The *Nipple* is a Spongy kind of *flesh*, and therefore is at sometines more loose and flaggy, and at other times more stiff, especially when suck'd or touch'd. The *Dug*, or *Pap* it self, inwardly consists of a *Membran*, *Vessels*, *Kernels*, or rather *Kernel*-like *Bodies*, and *Fat*. In *Men* the *Dugs* are not so great or prominent as in *Women*, theirs being not commonly designed for the *Generation* of *Milk*; yet to shew the Equality of kind in both *Sexes*, it was not fitting that Men should be altogether without them.

XI. *The Belly.* Under the *Breast* is the *Belly*, whose fore-part is called *Abdomen*, and in its Middle is the *Navil*; the upper part whereof is the *Hypochondrium*, which Name is also given to its Sides. Beneath are the *Groins*, and the *Parts* designed for *Generation*. The Upper-part of the *Abdomen*, reaching up to the *Midriff*, is the *Stomach*, which lies Cross-ways, and which having received the *Food* from the *Mouth*, by means of the *Gullet*, doth digest it into *Chyle*; and afterwards sends the purer part of the *Chyle*, by the *Subclavial Branches* of the *Vena Cava*, into the *Vena Cava* it self.

XII. *The Back-parts of the Body.* The Hinder-parts of the *Body* are the *Shoulder-blades*, to which the *Shoulders* are joyned, and to them the *Arms* with the *Elbow*. For by the word *Arm*, we understand all that part which reacheth from the *Shoulder*, where the *Collar-bones* end, to the *Fingers* ends; tho' commonly the *Hand* is not comprehended under the word *Arm*. The *Arm* consists of 3 conspicuous *Parts*, *viz.* the Upper-part of it called *Lacertus*; the Middle-part of it, from the *Elbow* to the *Wrist*, called *Cubitus*, and the *Hand*. The Upper-part of the *Arm* hath one only *Bone*; the Middle-part hath two *Bones*; the Lower, which is called *Ulna* or *Cubitus*, and the Upper called *Radius*. The *Hand* also consists of 3 *Parts*, *viz.* the *Wrist*, the part between the *Fingers* and the *Wrist*, called *Metacarpium*, and the *Fingers*; the *Fingers* have each of them 3 *Joints*. The *Hands* are 2, the *Right* and the *Left*. Next to the *Shoulders* are the *Loyns*, and near to them the *Os Sacrum*, distinguish'd as it were into 5 *Bones*, having on each side of it the Bone *Ilium*, jetting out like a *Bow*, and the *Hip-bone*; and under these the *Buttocks*.

XIII. *The Flesh.* The use of the *Flesh* is, to cover the *Bones* and *Members* of the *Body*, more especially the *Inward parts*, and to hinder them from falling asunder. It is made up of the *Substance* of the *Blood*, by the coagulation of its thicker Parts. The *Fat* in its nature is like to *Flesh*, and proceeds from the same *Principle*. Its Function is to preserve the *Natural heat*, to defend the Parts it covers from *Outward hurts*, and by moistning and smoothing the dryer Parts of the *Body*, to assist and promote *motion*.

XIV. *The Differences of Flesh.* *Flesh* is fourfold; *Viscerous*, *Membranous* or *Skinny*, *Glandulous*, and *Musculous*, or that of the *Muscles*. The *Viscerous* is that whereof the *Inwards* consist, and is nothing else but an affusion of *Blood*, which supports the *Vessels* of the *Inwards*, by filling the empty Spaces that are between them, and assists the Concoctions and Separations that are made in them. The *Membranous Flesh* is nothing else, but the *Fleshy Substance* of every *Membranous part*; as of the *Gullet*, the *Stomach*, the *Guts*, the *Womb*, and the *Bladder*. *Glandulous Flesh* is that of the *Kernels*; the use whereof is either to soak up the superfluous *Humours* (for they are of a *Spongy Substance*) as those in the *Neck*, under the *Armpits*, and in the *Groin*; or they are in order to the moistning of the *Parts*, for their more ready *motion*, or to prevent the dryness of the Parts. The *Musculous*, which GALEN calls the *fibrous* or *stringy Flesh*, is that soft and red Substance, which is *Flesh*, properly so called.

XV. *The Bones.* The *Bones* are the strength and support of the *Flesh*, and are the insensible Parts of the *Organical Body* of an *Animal*; as also the hardest and driest, containing the *Marrow* within them. There are 304 of them in the *Body* of *Man*, which are of diverse *figures*, according to their different uses; for some of them are round, others flat; some sharp, and others blunt, &c. It is a mistake to think the *Bones* to be without *Blood*; for they are Red in the *Womb* before the *Infant* is born, are found to have small *Vessels* in them, from whence *Blood* gusheth forth; and when they are broke, the *Callous matter* that joyns them again together, *sweats* *Blood*. The *Muscles* follow the bigness and *figure* of the *Bones*, to which they are joyned; and move those *Members* of the *Body*, to which they are particularly destinated. The *Nerves* or *Sinews* have *fibres* or *strings*, extended long-ways, and are the Instruments of *Sense* and *Motion*.

XVI. *The Feet.* Lastly, This whole *Bulk* is supported by the *Feet*, assisted with the *Leg* and the *Thigh*, with the *Knee* that joyns them both together. The *Thigh* hath only one *Bone* in the Upper-part, whereof, besides the round *Head*, inserted in the hollow end of the *Huckle* or *Hip-bone*, there is a kind of *Neck*, whence 2 Ends shoot forth, which are called *Trochanteres*: And in the Lower-part this *Bone* is so joyned with the *Chief-bone* of the *Shin* or *Leg*, that in the foremost Hollow of the jetting out of the *Bone*, there is a place for the *Bone*, called the *Knee-pan*, which hinders the *Leg* from bending forwards. To the Lower-part of the *Foot* 3 parts concur, *viz.* the *Heel*, the *Sole* of the *Foot*, which is as it were its Back, and is made hollow in the midst,

midſt, to the end it might the more firmly ſtick to the Ground in going; and the 5 *Toes*, which are very helpful to progreſſive *motion*.

CHAP. III.

A Deſcription of the Principal Inward Parts of the Body of Man.

I. *The Brain, which is the moſt principal Part of Mans Body, examined.*

THe *Skin* being pluck'd off, the *Fleſh* is more diſtinctly perceived; which is not a continuous *Maſs*, but diſtinguiſh'd into ſeveral *Muſcles*. But the chiefeſt and moſt principal Part that preſents it ſelf, is the *Brain*; which in *Man* is the greateſt in Bulk, with relation to other *Animals*. The *Bark*, or outſide part of it, appears diſtinguiſh'd into a thouſand turnings and windings, not unlike the Cronckelings of the *Guts*, with far greater variety than in any other *Animal*. All which crooked Windings are covered with a *thin Membran*, and are moiſtened with innumerable *Veſſels*; which being in a moſt wonderful manner woven together, are diſperſed every way, and in ſome places penetrate the inward Subſtance of the *Brain*. Tho' indeed all the *Veins* and *Arteries* that penetrate the *Subſtance* thereof, are but ſmall and few; but are more copious in the *Cavities* or *Ventricles* of it, and other places which are cover'd with the *Pia mater* or thin *Meninx*: For that *Membran* doth not only ſeparate the *Brain* from the more inward Part that lies under it, but diſtinguiſheth it alſo in divers parts, and inveſts all the deep furrows and foldings of the *Bark* or outward part of the *Brain*, conjoyns the more prominent parts of them, forms almoſt innumerable Cavities, and every where twiſts moſt wonderful pleats and textures of the *Veſſels*.

II. *The Brain is divided into two Parts.*

The *Brain* is divided into 2 parts, *viz.* into the *Fore* and *Hind-part*: The *Fore-part*, which is much bigger than the other, is chiefly called the *Brain*; the *Hind-part* is called *Cerebellum* or the *Little Brain*; and tends downward, being continued to the Marrow of the *Back-bone*, and cover'd with both the *Meninges*. Within the *Subſtance* of the *Fore-part* are two *Cavities*, ſo placed as to anſwer to a third Cavity in the *Hind-part*: And above the Paſſage, whereby the foreſaid 2 Cavities have entercourſe together, is the famous *Kernel* called *Glandula Pinealis*, from its *figure*, reſembling that of a *Pine-Apple*, and *Conarion* from its *Conical figure*. The bottom of this *Gland* or *Kernel* is faſtned to the *Brain*, whereof it is a part, and is ſeated in the very midſt of the two *Cavities* This *Kernel* hath that of Singularity, that it is one only, whereas all the other that are found in the *Brain* are double.

III. *Of the ſeven pair of Nerves, derived from the Brain, according to the Opinion of the Ancients.*

The *Ancients* were of Opinion, that 7 pair of *Nerves* only were derived from the *Brain*; whereof the firſt, were the *Optick Nerves*; the ſecond, thoſe that help to move the *Eyes*; the third and fourth, appropriated to the *Taſte*; the fifth, to the *Ears*; the ſixth was, that which is called the *wandring Pair*; and the ſeventh and laſt, thoſe that move the *Tongue*. But in this enumeration, they have left out that *Pair*, which being convey'd to the *Noſtrils*, are the Inſtruments of *Smelling*, and have divided the third *Pair* into two; and the fifth *Pair*, which they ſuppoſe ſingle, is double: So that whereas they make but 7, others 8, and others 9 Pair of *Nerves*, we make 10 in all. The *firſt Pair* are appropriated to the *ſenſe* of *Smelling*, the ends whereof reaching from the *Brain* towards the *Noſtrils*, are called *Proceſſus Mammillares*. The *ſecond* is the *Optick pair*, ſubſervient to the *Senſe* of *Seeing*. The *third*, moves the *Eyes*. The *fourth*, ſerves to turn and writh the *Eyes* variouſly, ſuitable to the diverſity of *Paſſions* that aſſail us. The *fifth* is, that by which the *Tongue* doth *taſte*. The *ſixth* is conveyed to the *Palat*, for the ſame purpoſe. The *ſeventh* is loſt in the *Muſcle* of the *Eye*, called the *Abductor* or *Drawer aſide*. The *Eighth* aſſiſts the *Drum* of the *Ear*, in its dilatation or expanſion. The *Ninth pair*, which is called *Wandering* by others, is that which furniſheth all the *Inward parts*, ſituate in the middle and lower *Belly*. The *Tenth* and laſt *Pair* is by ſtrong *Membrans*, joyned with the former *Pair*, for the ſtrengthning of them.

IV. *Several Pairs of Nerves proceed from the Pith of the Back-bone.*

But foraſmuch as the *pith* of the *Back-bone* is nothing elſe, but a *Continuation of the ſubſtance of the Brain*, it is certain that from the ſame ſeveral *pairs* of *Nerves* do proceed; *viz.* 7 to the *Neck*, 12 to the *Back*, 5 to the *Loyns*, 6. to the *Os ſacrum*; and all theſe *Nerves* are nothing elſe, but the continued Subſtance of both the *Meninges* or *membrans* of the *Brain*, there being none amongſt them that are not twiſted of them both. Theſe *Nerves* proceeding from both ſides of the *Pith* of the *Back-bone*, are called *Pairs*, as being always double.

V. *The Heart.*

In the *Breaſt* hangs the *Heart*, of a *Pyramidal figure*, reſembling a *Pine-Apple*, with the Point of it inclining towards the Left-ſide; ſo as that the Left-part of the broad End, which is the beginning of the *Great Artery*, is ſituated much about the *Center* of the *Cheſt*. The Greatneſs of the *Heart* in *Man*, proportionably exceeds that of other *Animals*, and commonly weighs about 7 *Ounces*, being about 6 Finger-breadths long, and 4 broad. Not but that the bigneſs thereof ſometimes varies.

VI. *Of the Dilatation and Contraction of the Heart.*

In the *Heart* are 3 ſorts of *Strings* or *Fibres*, ſome *Tranſverſe* or *Croſs-wiſe*, others *Crooked* or *Oblique*, and a third ſort that are *Strait*, by which the *dilatation* or *ſwelling* of the *Heart*, when the Point of it is drawn up towards the broad End of it; and the *Contraction* whereby the ſaid Point is withdrawn from the *baſis* or broad End of it, are performed. There be 2 *Ventricles* or *Cavities* in the *Heart*, which are ſeparated from each other by a part of the *fleſh* of the *Heart*, called the *Septum medium*, or the middle partition Wall, the *Right Ventricle* being more ample and large than the *Left*. Two very large *Channels* anſwer to both theſe *Ventricles*, to wit, the *Vena Cava*, which is the principal *Receptacle* of the *Blood*, and is as it were the *Trunk* of the *Tree*, whereof all the other *Veins* are the *boughs* and *branches*; and the *Arterial Vein*, which ariſeth from the *Heart*, and after that it is come forth from thence, divides it ſelf into many *branches*, which are afterwards diſperſed through the *Lungs*. In the Left-ſide there are likewiſe 2 correſponding *Channels*, as large as the former, if not larger, *viz.* the *Venal Artery*, which is derived from the *Lungs*, where it is divided into many *branches*, which are intermixed with the *branches* of the *Arterial Vein* and the

Wind-

Wind-pipe, by which the *Air* we attract doth enter; and the *Great Artery*, which proceeding from the *Heart*, diſperſeth its *branches* throughout the whole *Body*. Each of theſe *Cavities* have 2 *Openings*, placed towards the *baſis* or broad End of the *Heart*: And in the entrance of theſe Openings, are ſome *little Skins*, which like ſo many *floodgates* do open and ſhut 4 *Mouths* or *Orifices*, that are in both thoſe *Cavities*; *viz.* 3 in the entry of the *Vena Cava* or *hollow Vein*, which are ſo placed, that they cannot hinder the *Blood* they contain, from flowing into the Right *Ventricle* of the *Heart*, tho' they hinder any from coming out thence. 3 in the Entry of the *Arterial Vein*, which are ranged the quite contrary way, ſo as that they ſuffer the *Blood*, contained in that *Cavity*, to paſs to the *Lungs*; but by no means will ſuffer that which is in the *Lungs*, to return thither again. And ſo likewiſe there are 2 more in the *Orifice* of the *Venal Artery*, which permit the *Blood* to paſs from the *Lungs* into the Left *Ventricle* of the *Heart*, but hinder its return thither again. And 3 at the entry of the *Great Artery*, which ſuffer the *Blood* to come from the *Heart*, but hinder it from returning thither again.

VII. *The ſituation of the Heart, in the Breaſt.* The *Heart* is encloſed in a *Nervous membran*, called *Pericardium*; where it ſwims in a *Liquor* not much unlike to that of *Urin*; the broad End of it taking up the *Center* of the *Breaſt*, whilſt the Point of it ſways downwards, to the Left-ſide of the *Midriff*.

VIII. *The Lungs.* The *Lungs* are a *Spongy ſubſtance*, of a whitiſh or pale *red Colour*, and are divided in the Right and Left part by the *Mediaſtinum*, or the *membran* that divides the *Breaſt*, from the *Throat* to the *Midriff*, into 2 *Boſoms*; both which Parts are diſtinguiſh'd into ſeveral *Lobes* or *Lappets*, in order to their better covering and ſurrounding of the *Heart*, which is placed in the midſt of them. In that part of the *Mouth* which is at the *Root* of the *Tongue*, is a *Channel* called the *Wind-pipe*, which paſſing downwards is divided into many little *branches*, which are diſperſt throughout the whole Subſtance of the *Lungs*, in the ſame manner as the *Venal Artery*, or the *Arterial Vein*. This *Wind-pipe* receives the *Air* that is taken in by *breathing*; and becauſe the *membran* thereof is ſo hard and ſtiff, that it cannot eaſily be compreſt or clos'd together, it continues always full of *Air*, and by this means cauſeth the great Lightneſs of the *Lungs*. Our *Meat* and *Drink* cannot paſs from our *mouth* into the *Gullet*, without paſſing over the *Mouth* of the *Wind-pipe*, tho' nothing can fall into it, becauſe of a little *Valve* which covers it, whenever we ſwallow any thing. The *Lungs* alſo have their *Dilatation* and *Contraction*; their *Dilatation* being cauſed by the *Air* entring into their *Subſtance* through the *Wind-pipe*; and the *Contraction* by the expulſion of tt.

IX. *The Midriff* Under the *Lungs* and the *Heart* is placed the thick *membran*, called the *Diaphragm* or *Midriff*, which ſeparates the *Breaſt* from the *Belly*. It hath 2 *Holes*, through which the aſcending *Hollow Vein*, and the *Gullet* which goes down to the *Stomach*, do paſs. The *Midriff* lends alſo its aſſiſtance to the function of *Reſpiration*, to which it contributes rather, as it is a *Muſculous membran*, than a *Muſcle*.

X. *The Liver.* Under the *Diaphragm*, the *Liver* is placed on the Right-ſide, and the *Spleen* on the Left. The *Liver* in *Man*, as well as in moſt other *Animals*, ſeems to be nothing elſe but *Clotted blood*, of a *Reddiſh colour*. Tho' there be ſome *Animals* that have it of a *green*, others of a *yellow*, and others of other *Colours*. The *Ancients* were of Opinion, that the *Blood* was prepared in the *Liver*, and that the *Chyle* was there turned into the form of *Blood*. But the contrary has been ſince made out, it being no longer queſtion'd now, but that the *Chyle* is conveyed from the *Receptacle* of the *Lacteal Veins* upwards, to the *Subclavial branches* of the *Hollow Vein*, and thence into the aſcending *Trunk* of the ſaid *Hollow Vein*, whence it is carried together with the *Blood*, returning from all the *parts* of the *Body*, into the Right *Ventricle* of the *Heart*, without paſſing the *Liver*. The *Gall-bladder* is joyned to the *Liver*, a ſmall *Channel* proceeding from it, which becomes immediately parted into 2, whereof the one bends downwards towards the *Liver* again, and enters it; whereas the other, called *Choledochus*, is inſerted into the lower end of the *Duodenum*, whither the *Gall* is conveyed, through a very little and almoſt inſenſible *Orifice*.

XI. *The Spleen.* The *Spleen* is ſituated on the Left-ſide, under the *Midriff*, between the *Stomach* and the *Ribs*. It is of a *Spongy ſubſtance*, cover'd with a thin *membran*, received from the *Peritonæum* or *Inner-rim* of the *Belly*. Its more prominent or gibbous part is faſtned to the *Midriff*; which is the Reaſon why thoſe that are *diſeaſed* with a *Schirrus*, or any other *ſwelling* of the *Liver*, do complain of a difficulty of *breathing*. It abounds with a thick *dreggy Blood*, and is faſtned to the *Stomach* and *Back*, by means of the foreſaid *membran*, and hath a communication with the *Heart* by certain *Arteries* and *Veins*. The *Spleen* is almoſt as long again as it is broad; the Upper-part of it butting out like a *Bow*, the Lower-part of it ending in an obtruſe *Angle*, and in the midſt ſomewhat hollow and depreſt.

XII. *The Stomach.* Betwixt the *Liver* and the *Spleen* lies the *Stomach*, into which all our *Meat* and *Drink* is conveyed through the *Gullet*. It hath 2 *Orifices*, the one whereby it receives in our Nouriſhment, which it diſſolves and turns into *Chyle*; the other called *Pylorus*, by which it thruſts it down into the *Guts*.

XIII. *The Guts.* For the *Guts* take their riſe or beginning from the neather *Orifice* of the *Stomach*, and after many windings are terminated in that part, by which the groſſer *Excrements* are voided. To ſpeak properly there be no more than *one Gut*, to the different parts whereof *Anatomiſts* have aſſigned different Names. That which is next to the *Stomach* they call *Duodenum*, the extent of which is not above 12 *fingers* breadth: The ſecond is called *Jejunum*, from its almoſt continual emptineſs: The third is called *Ilium*, from its various windings: The fourth, *Colon*, whence the Diſeaſe called the *Colick* takes its Name: The fifth is a little Appendix betwixt the *Ilium* and *Colon*, which is called *Cæcum*, or the *Blind-Gut*: And the ſixth *Rectum*, or the *Strait-Gut*. The 3 former of theſe are called the *thin Guts*, and the reſt the *great* or *thick Guts*.

XIV. *The Meſentery.* The *Meſentery* is a *Membranous* expanſion, interwoven with *Kernels* and *Fat*, placed at the back-part of the *Guts*, and with its *Center* or narroweſt part tied to the *Loins*; but with its Circumference

cumference infolding all the *Guts*, and faſtning them to the *Back*. Its *figure* is almoſt Circular, ſo as that its compaſs anſwers to the length of the *Guts*; but yet is ſo framed and folded, that it keeps within narrow Bounds.

XV. *The Caul.* The *Caul* is another *Membranous expanſion*, conſiſting of a double *membran*, diſtended to an Orbicular *figure*, like to a *Faulkners Pouch*, interwoven with many *Arteries* and *Veins*, and great ſtore of *Fat*, deriving its 2 *wings* or foldings from the *Stomach*, *Liver*, *Spleen*, the *Rim of the Belly*, and the Gut *Colon*; and not only covering the *Guts*, but following the windings and turnings of them; ſo that with regard to its ſituation it may well be called *Epiploon*, that is, ſwimming on the top, ſuch being the ſituation of it with reſpect to the *Guts*.

XVI. *The Womb.* The *Womb*, which is alſo called the *Matrix*, is an *Organical part*, ſerving for *Generation*, ſituate in the lower part of the *Belly*, betwixt the *Bladder* and the *Strait-Gut*, lodged in a ſtrong *Baſon*, made by the Bones *Ilium*, *Coxendix*, and *Sacrum*; which *Baſon* or Hollow is larger in *Women*, than in *Men*, in whom alſo when the time of their Delivery is at hand, it is yet further enlarged by the plying and giving-way of ſome of the ſtrong *Ligaments* about the Bones *Sacrum* and *Pubis*, and by the ſtarting back of the *Bone* called *Coccyx*, to make way for the *Birth* to ſtruggle out of his *Priſon*.

XVII. *The Kidneys.* Beſides theſe Parts already mentioned, there are alſo 2 *Kidneys* that are faſtned to the *Joints* of the *Back-bone*. Their Subſtance appears like to that of a curious *Sponge*, and in each of them is found a certain Cavity or Hollow, called the *Diſh* or *Baſon*, which is generally fill'd with *Urin*.

XVIII. *The Ureters.* The *Ureters* are 2, *viz.* on each ſide one, carrying the *Urin*, that hath been ſeparated in the *Kidneys* to the *Bladder*. They are nothing elſe, but an innumerable company of ſmall *Nervous fibres* twiſted together, and therefore no wonder that they are ſo exceeding ſenſible; for as ſoon as any one of their fineſt Strings is moved, all the reſt are ſhaken and tremble, whence there ariſeth in the *Soul* an *Idea* of the ſharpeſt Pain.

XIX. *The Bladder.* *Anatomiſts* commonly attribute but 2 *Coats* or *membrans* to the *Bladder*; but if they be viewed with a *Microſcope*, we ſhall find them to be many more, even to the number of 20. The *Bladder* is the receptacle of the *Urin*, conveyed through the *Ureters* from the *Kidneys*; which afterwards by the contraction of the *fibres* of the *Bladder*, are by the *Urethra* or *Urinary-paſſage* evacuated.

XX. *The Teſticles.* The laſt Parts to be conſider'd, are the *Teſticles*, which are *Veſſels* deſign'd for *Generation*, tho' it may be doubted, whether the Generation of *Seed* may be wholly attributed to them; becauſe there was never found any perfect *Seed* in the *Teſticles* of the moſt Libidinous *Animals*. Yea, many do witneſs, that *Bulls*, *Horſes*, and other ſuch like Robuſt *Animals*, have generated their Like for many years together, after their having been *gelt*, and that they are not robb'd of their *Prolifick virtue*, except their *Spermatick Veſſels* be taken away together with their *Teſticles*. Wherefore it ſeems more probable, that the *Seed* is produced in the little *Bladders*, *Kernels*, and *Pores*, that neighbour upon the *Bladder* and the *Womb*. But we leave this to be determin'd by *Phyſicians*.

CHAP. IV.

Of the Forming of the Birth in the Womb, and of its Animation.

I. *Whether the Seed in Generation, proceeds from both Sexes.* THE Common Opinion is, that the Matter whereof the *Birth* is formed in the *Womb*, doth conſiſt of the *Seed* of both *Parents*, the Female *Blood* being mix'd with it: Nor indeed have the *Ancients* queſtion'd, but that the *Woman* doth contribute her part of *Seed* to the *Conception*, and efficiently concur to *Generation*; for both *Sexes* ſeem to have like *Inſtruments* for the *generating of Seed*. The *Women* have their *Teſtes*, in which the *Blood* is ſtrained and purified, and a ſerous and thickiſh *white Matter* is ſqueezed out of them, which ſeems to be deſign'd for *generation*. Beſides, we find that the *Birth* reſembles the *Mother*, as well as the *Father*; which we cannot well conceive how it ſhould be, if both of them did not contribute *Seed* to the production thereof.

II. *The Seed flows from all parts of the Body.* But to the end we may underſtand by what *Artifice* an *Animal* comes to be formed, from a Moiſture without all Form, ſo as to bear ſome reſemblance with the *Principle* from whence it did proceed; it is commonly ſuppoſed, that the *Seed* both of *Male* and *Female* flows down from all their Parts, ſo as that there is no *Member* in their whole *Bodies*, whence ſome part of the *Seed* is not derived. For as the *Serous humour* is by the *Veins* ſeparated from the whole *Body*, and through the *Veſſels* call'd *Emulgentes* carried to the *Kidneys* and *Bladder*, in which latter place it is kept till it be voided: In like manner, ſay they, ſeeing that 2 *Veins* and 2 *Arteries* enter into the *Teſticles*, why may not the *Seminal particles* flow from the whole *Body* into them, and from them into the *Veſſels* deſtinated for their reception; and this not ſlowly and by degrees, but in a very ſhort Space, wherein the whole *Body* is powerfully ſtirr'd up to an excretion or ſeparation of what is moſt *Spirituous* in all the Parts of the *Body*?

III. *Proved by Examples.* Many *Arguments* might be alledg'd to prove this Point; but there are ſome Examples thought to be ſo clear and evident, as to ſuperſede the neceſſity of many *Proofs*: A *Cat*, whoſe *Tail* was cut off when ſhe was but young, litter'd *Kitlings*, whereof ſome had *Tails*, and others wanted them: And a *Bitch*, that was wont to bring forth ſound *Puppies*, having broke her *Leg*, did ever after bring forth lame *Puppies*. Now to what can this reſemblance of *Puppies*, with their *Dams*, be imputed, but becauſe the *Seed* is conveyed from all the parts of the *Body*, ſo that perfect *Births* are born of ſound and perfect *Parents*, and maimed and defective from ſuch as are ſo. And if it ſometimes happens, that whole and ſound *Births* do proceed from maimed and defective *Parents*, this muſt be aſcribed either to the Soundneſs of one of the *Parents*, or to the great Vigour of the *Spirits*. However, when it ſo happens that *maimed Births* proceed from *maimed Parents*, no other Reaſon ſeems ſo ſatisfactory, as that which hath been alledged.

IV. *How the Birth is formed in the Womb.* From what hath been ſaid, may in ſome ſort be underſtood, how the *Birth* comes to be formed in the *Mothers Womb*; becauſe the inſenſible Parts of the *Male* and *Female Seed* have already received ſuch a *Configuration* in the *Body* of the *Parents*, that they are no ſooner received into the *Womb*; but

but being there intangled together, and agitated by *heat*, they are turned into a rude *delineation* or *Rudiment* of the *Animal*, from which afterwards all the parts are perfected and compleated. For thoſe parts which before, for example, did belong to the *Head*, *Belly*, *&c.* become now ſo diſentangled and ſeparated from others, ſo as to be now at liberty to run together, and from the ſeveral diſtinct parts of the *Body*; ſo that thoſe parts which proceeded from the *Brain*, do now unite to conſtitute that part, thoſe of the *Eyes*, the *Eyes* and ſo for the reſt. Much after the ſame manner as the like *grains* of *Sand*, and the *filings* of *Lead* do come together, and make ſeveral *heaps*: as when we faſten a *Pipe* to a *Bladder*, and through it caſt *Earth*, *Sand* and *Filings of Lead*, and having poured *water* upon them, if then we blow through the *Pipe*, all theſe *matters* will be variouſly mingled and toſt together, but as ſoon as the ſaid agitation ceaſeth a ſeparation is made, the *Lead* ſetling with the *Lead*, the *Sand* with the *Sand*, *&c.* and in this condition we ſhall find them, if after the drying up of the *water* we ſhall rend the *Bladder*, that is, we ſhall find the like *particles* to be gathered to their like. And after this manner we may conceive that the *particles* of the *Seed* become ſo diſpoſed as to make the firſt *Rudiment* of a *Birth*.

V. *How the firſt Rudiment of the Birth comes to be like Man.*

If you demand how it can be that from ſuch a ſmall quantity of Inſenſible *particles*, a *Body* ſhould ariſe, reſembling the great *Body* from whence it proceeded, and repreſenting every one of its Parts and *Members*.

It is Anſwered, that this is done much in the ſame manner as we find that a very little *Image* in a *Convex Glaſs* repreſents a *Man*; for this *Image* is therefore ſo little, becauſe only a few rays are reflected to the *Eye*, from the ſeveral parts, many of the *Rays* rebounding elſewhere by reaſon of the convexity of the *Glaſs*, which makes that only a few *Beams* from each part do reach the *Eye*, which meeting in the *Retina* or *Network Membran* of the *Eye*, do repreſent a very little *Man*: In like manner, the firſt Rudiment of a *Human Birth* in the *Womb*, is indeed very little, and yet reſembles the great *Body*, exactly as to the number of its parts, tho' not as to the quantity and bulk of them.

VI. *The Time of the Formation of the Birth.*

Phyſicians are at ſome diſagreement about the time of the *formation* of the *Birth*. *HIPPOCRATES Lib.* 1. *de Carn.* tells us that the *Seed* being received into the *Womb*, by the ſeventh day hath whatſoever it ought to have, and that if an Abortive at the end of this term, be put into the *water*, and accurately viewed, the rude draught of all the parts will be diſcernible in it. Others allow a longer time for this forming of all the *Parts*: *ARISTOTLE Lib.* 7. *Hiſt. Animal.* ſaith that the *Body* of the *Birth* on the fortieth day, conſiſts, as it were, in a *Membran*, which being rent, the *Birth* appears of the bigneſs of a great *Piſmire*, in which all the *Members* may be diſtinctly ſeen.

VII. *What the Architectonick or Plaſtick virtue is.*

Now what this *Plaſtick* or *formative virtue* is that lies hid in the *Seed*, which begins and carries on the *formation* of the *parts*, all are not agreed. *GALEN* ſometimes calls it *Nature*, ſometimes *Native Heat*, ſometimes the *Inborn Temperament*, and ſometimes *Spirit*, which in his Book *de Trem. & Vigor.* he determines to be *a ſubſtance moveable of it ſelf, and always moving*. *Ariſtotle, Lib.* 2. *de Generat. Animal. Cap.* 3. diſtinguiſhing betwixt the *Heat* or *Spirit* of the *Seed*, and *Nature*, ſaith that the *Plaſtick Virtue*, is *the Nature that is in the Spirit of the Seed*. *AVICENNA* and others following *AVERROES* call it a *Cœleſtial Power*, or *Divine Virtue*. Some admit no other *Soul* in *Man* but the *Rational*, and maintain that it alone, out of convenient *ſeminal matter* offered to her, doth perfect all the *Lineaments* of the *parts*, and that ſhe is the *Architect* of her own *Houſe*. Others affirm that there is a *Vegetative* or *Vital Soul* in *Man*, which is *Mortal* and diſtinct from the *Rational*, and that this *Soul* is the chief, yea ſole Operator in the forming of the *Birth*, and the very ſame which ſome call the *Plaſtick* or *Architectonick Virtue*.

VIII. *What Parts of the Body are firſt formed.*

The *Antients* differ alſo, as to what parts of the *Body* are firſt formed. *ARISTOTLE* was of opinion that the *Heart* was firſt formed, as being the *Fountain* of *Heat*, and the *Principle* of the *Animal Life*. For it ſeems very conſonant to *Reaſon*, that what dies laſt, ſhould have the precedence in *formation*. Others ſuppoſe that all the *parts* of the *Birth* are formed at once, and contend that there is no reaſon why the *Heart* ſhould have any ſuch Præeminence allow'd it. For why, ſay they, ſhould the *Heart* be formed before the other *parts*, ſeeing that in the framing of the *Members*, the *Birth* doth no more ſtand in need of the Influence of the *Heart* than of the *Senſe* of the *Brain*? *Nature* digeſts the whole *Maſs* of the *Seed* with one and the ſame *Heat*, which equally penetrates all the *parts* of it; ſo that when ſhe begins to frame a *Body*, ſhe doth not confound the particles of the *Seed*, but diſtributes them all into their ſeveral *places*. Which diſtribution of the *Seed* cannot conſiſt with a ſucceſſive *Generation* of *Parts*; ſeeing it is equally requiſit, that a part fit to form the *Brain* ſhould be taken from the *Heart*, as it is that the *Brain* ſhould communicate a part proper to conſtitute the *Heart*: Beſides, *Nature* might be accuſed of Impotence, if ſhe could not perfect and compleat thoſe things together at once, which ſhe hath begun at once.

IX. *All Parts of the Birth are formed together, notwithſtanding that ſome parts be ſeen before others.*

Neither is it contradictory to this aſſertion, that ſome parts appear to us before others, becauſe this is only to be attributed to their greater bulk. For the greater parts ſeem by Nature to be *before* the leſs; but we cannot therefore infer from hence that they exiſt before them; becauſe all the *Members* of the *Body* are not perfected and compleated at the ſame time, but according as they are more or leſs *nouriſhed* or *heated*. Wherefore *HIPPOCRATES Lib.* 1. *de Diæta* ſaith that *all the Members are diſtinguiſht and encreaſe together; not one before or after the other; tho' thoſe parts which be greater by Nature than others, do appear before the leſſer, but do not exiſt before them.* For the order of *Nature* is, that the more worthy parts, and thoſe that are deſigned for the uſe of others, ſhould appear firſt, and therefore it is that the upper parts appear before the lower, and thoſe which are formed of the *Seed*, before thoſe that are formed of the *Blood*. But yet it ſometimes happens, that the more imperfect parts are framed before others, as is manifeſt in the *Navel*, which is perfected before either the *Heart* or *Brain*.

This

X. *This further proved from a Chicken.*

This may be proved by Experience; because never was there any *Birth* found, in which the *Heart* or any other part was formed, before the other parts were framed also. For tho' in the forming of a *Chicken*, about the fourth day, the *Head* and *Body* of the *Chicken* begin to appear, when neither *Wings* or *Legs* are yet distinguishable, yet even at that time the *Rudiments* of those parts are there, tho' so little as not discernible by the bare *Eye*. And thus much concerning the opinion of the *Antients* about the forming of the *Fœtus*.

XI. *Dr. Harvey's opinion concerning Conception.*

Dr. *HARVEY* was the first of Modern *Authors* who maintained, that the *Masculine Seed* did not concur to the constitution of the *Birth*; because in the many *Animals* he dissected after *Copulation*, he never found any *Seed* in their *Wombs*, and therefore was induced to believe, that the *Seed* of the *Male* did never reach the hollow of the *Womb*, or if it did, that it never staid there, but soon after slipt away: and accordingly he supposed that the *Male-seed*, only by a prolifick breath or contagion, doth make the *Female* conceive. *Secondly*, That the Natural *Conception* in the *Womb*, happens much in the same manner, as doth the *Animal Conception* in the *Brain*: for as we, after having framed an *Idea* in our *Brain*, do express the likeness of it in our *Works*; so likewise the *Idea* or *Species* of the *Begetter*, tho' the *Geniture* or *Seed* be absent, by the help of the *Formative Faculty*, doth beget a like *Birth*, by impressing the *Immaterial Species* it hath upon its work.

XII. *How Conception is performed according to Steno, and other later Physicians and Anatomists*

In the year 1670, *STENO* a famous *Anatomist*, discovered that the *Female Testicles* so called, are nothing else but *Ovaria*, that is, Receptacles of *Eggs*, which hath been since confirmed by the *Writings* of KERCKRINGIUS, SWAMMERDAM, GRAAF, GASPAR BARTHOLINUS and others. And accordingly the received opinion now is, that the *Birth*, with all its parts, lies hid in these *Ovaria*, tho' not to sensible appearance. And therefore maintain that the *Birth* is not formed of the *Seed*, but that the most *Subtil Spirit* only of the *Masculine Seed* is conveighed through the bottom of the *Womb* and the *Tubes* or *Trumpets* (so called by *FALLOPIUS* for their resemblance with that Instrument) to the *Female Ovarium*, where it impregnates one of those little *Eggs*, that is, causeth or excites a *Fermentation* in it, which makes the *Egg* to swell, and to require a greater space, by which means it cracks the common *Membran* of the *Ovarium*, and through the slit of it, is driven into the *Fallopian Tubes* by those shaggy edgings which are at the end of the said *Tubes*, and by *Anatomists* are called the *Leaf-work Ornament*, being blown up and distended by the *Animal Spirits*, and which at the time of *Copulation*, like so many *Fingers*, clasp themselves about the *Ovarium*; and thus the *Egg* is conveighed through the whole length of the *Fallopian Tubes* to the bottom of the *Womb*, where it is further hatched into a Living *Birth*.

XIII. *The Point illustrated from a similitude betwixt the Vegetation of Plants and Animals.*

The Learned Mr. *RAY* illustrates this matter in *his History of Plants* from the *Analogy* and similitude there is between the *Vegetation* and encrease of the *Seeds* of *Plants* in the *Earth*, and of *Viviparous Animals* in the *Womb*. For even as, saith he, the ripe *Seed* of a *Plant* falls down to the *Earth*, and being there free and at liberty, doth first of all attract the *Aliment* through the *pores* of its coverings, and afterwards shoots down *roots* into the *Earth*; so likewise the *Egg* of a *Viviparous Animal*, being by the *Masculine Seed* made Fruitful, and brought to Maturity, falls down from the *Ovarium* as from its *Tree*, into the *Womb*, as the *Earth*, where continuing for some time loose and at liberty, without being fastned to the *Womb*, it takes in its first *Aliment* through the involving *Membrans* or *Secundines*. These *Ovaria* are nothing else but the *Female Testicles* formerly so called, which he that diligently views will find them to be nothing else but a Cluster of little *Eggs*.

XIV. *Many difficulties may be solved from this Hypothesis.*

Admitting this opinion, we may easily resolve the following Difficulties, according to *SWAMMERDAM* in his *Miracle of Nature*, or *the Structure of a Womans Womb*. *First*, Why a *Parent* that wants *Arms* or *Legs* may notwithstanding propagate a *Birth*, perfect and compleat in all its parts; even because all the *Parts* of it are contained in the *Egg*. *Secondly*, So likewise that old and famous Question, whether the flowing of the *Seed* from all the parts of the *Body* be required to the perfection of the *Birth*, is readily answered. *Thirdly*, Hence it appears how *Levi*, long before his *Birth*, was said to pay Tenths, in, or with his Great Grand-father *Abraham* to *Melchizedeck*, to wit, because he was in the Loins of his *Parents*, as all the parts of an *Animal* are in the *Egg*. And *Fourthly*, Hence also may be explained and illustrated the ground and foundation of Original *Corruption*, because all Men that ever were, or shall be, were hid in the Loins of *Adam* and *Eve*, to whom therefore it may be easily conceiv'd, that that primordial Taint must have been necessarily propagated from these their First *Parents*.

XV. *At what time the Soul is infused into the Body.*

Now as to the time of the *Animation* of the *Birth*, Authors are likewise at great variance. *ARISTOTLE* supposeth that a *Male Body* receives its *Soul* the 42*d* day after *Conception*, and a *Female* on the 19*th*. Whereas *ÆNEAS GAZÆUS* will have the *Soul* not to be put into the *Body* already formed, but into the *Seed* it self, whilst it is yet without Form. *THOMAS FIENUS*, in his Book *de Format. Fœtus*, determins the Infusion of the *Soul* to be the *third* day. But if it be lawful to gues at a thing so obscure as this is, it seems most probable that the *Soul* is then joined to the *Body*, when it is furnisht with all its *Organs*, that is, after the formation of the *Belly*, *Heart*, *Brain*, *the Pineal Kernel*, and all the other *Parts*, which *Anatomists* tell us happens about the Fourth *Month*.

CHAP. V.

How the Body of Man is nourished and encreased.

I. *What Nourishment and Encrease is.*

FOrasmuch as those parts that are so turned into our *Substances*, as to preserve our *Body* in the same state and condition only, are said to *nourish* us; and that those parts, which being transmuted into our *Bodies*, do make it greater in Bulk than it was before, are said to *encrease* it, and make it *grow*, we may easily apprehend what *Nourishment* and *Growth* is.

The

II. *The Progress of our Food from our Mouth to the Stomach, Guts, &c.*

The manner how both these are performed will more plainly appear, by taking an exact view of the *changes* of those *Aliments*, whence the *Principles* of our *Blood* are derived. *First*, It is evident that, besides the *Culinary Preparation* of the *Aliment*, it is chewed by the *Teeth*, and being mingled with the *Spittle* is sent down into the *Stomach*. 2*ly*. That in the *Stomach* it undergoes a special *Fermentation*, whereby it is yet further dissolved. 3*ly*. That from this dissolved and digested *Mass*, by another peculiar effervescence or working in the *Guts*, are separated the more useful and pure parts of the *Chyle*, from those that are more thick and gross, which are yet farther dissolved and attenuated in the *Lacteal Veins*, and the *Kernels* of the *Mesentery*, as also by the Commixture of the *Lymphatick Juice*; and at last being mingled with the *Blood* in the *Veins*, are carried to the *Heart*; where having past another effervescence, they become united with the rest of the *Blood*, there being now no more any difference between them.

III. *How the Chyle is driven out of the Stomach into the Guts.*

When, I say, that the *Chyle* is driven out of the *Stomach* into the *Guts*, I do not thereby own any Expelling Faculty residing in the *Stomach*, as the *Antients* did suppose, this being done by the *Animal Spirits* flowing through the *Nerves* into the *Membrans* of the *Stomach*, and drawing them together. And forasmuch as these *Membrans* of the *Stomach* do immediately infold and embrace the *Chyle*, in a healthful state of the *Body*, the said Liquor must of necessity be expelled through the *Lower Orifice* of the *Stomach*, into the *Guts*, as is manifest from a *Bladder* filled with *water*, the neck of it being left open; for as soon as you press this *Bladder* with your Hands, the *water* gusheth out immediately at the *Neck*. Moreover, the pressure of the neighbouring parts, as of the *Liver*, *Spleen*, *Guts*, *Midriff*, *the Pancreas*, or *Sweet-bread*, and especially of the three last, contribute much to this Expulsion: for the *Midriff* is driven downwards by constant *Inspiration*, and pusheth upon the *Stomach* that lies under it, as may be seen in the *cutting up of Living Beasts*.

IV. *The nourishing of the Body is performed by the help of the Blood*

And forasmuch as it is observed that a *Body* cannot be nourished, as long as the *Blood* continually flows from it, but that on the contrary it wastes and consumes; we may well conclude, that *Blood* concurs to the *Nutrishment* of the *Body*, and that it is a *substance*, which acquires another nature, so as to supply those parts that are dissipated, and turn to *Excrement*.

V. *The opinion of the Antiens concerning Nutrition and Growth.*

Which Change the *Antient Physicians* explained, by saying, that when the *Blood* was come to the utmost parts of the *Branches* of the *Capillary Veins*, it *sweat* through them in the form of a *Dew*, which afterwards turned into *substance* not unlike to *Glew*, of a mean consistence; which *Glewy substance* was then attracted by the several parts of the *Body*, according to their several needs. So as that the *Flesh* attracted those *particles* that were most proper to be changed into *Flesh*; the *Bones*, the most fit to be turned to *Bones*; and that the same *Attraction* and *Assimilation* was performed by the help of 2 *Faculties*, the one whereof they called the *Attractive*, and the other the *Assimilative Faculty*.

VI. *This opinion rejected.*

But forasmuch as there is no such *Attraction* in our *Bodies*, and that our parts are not endued with any knowledge whereby they might be able to distinguish such *particles* of the *Blood* as are like and fit for them, from those that are otherwise; this opinion seems to be very contrary to Reason. Neither do they make out, how the *Venal* and *Arterial Blood* comes to be changed into *Dew*, and thence into a *Glew*; neither can they demonstrate what those wonder-working *Attractive* and *Assimilative Faculties* are, they do so much talk of.

VII. *How Nutrition and Growth are performed.*

We say therefore, that the *Nutrition* of *Mans Body* is thus performed. The *Blood* being come forth from the *Heart*, wherein it hath received its utmost perfection, is driven towards the ends of the *Arteries*. For as soon as the *Arteries* become dilated, and as it were blown up, the small *particles* of the *Blood* they contain, run against the roots of some *Filaments*, which proceeding from the *Extremities* of the *Branches* of the *Arteries*, do constitute the *Bones*, *Flesh*, *Skins*, *Nerves*, *Brain* and the other solid *Members*, according as they are in themselves of a several *Juncture* or *Texture*, and thus have the force to drive them a little forwards, and to take up their places. And then as soon as the said *Arteries* fall again, they leave the *particles* of *Blood* in the several places wherein they are, which abiding there, are by this means united to the part they touch. Now supposing this to be the *Body* of an *Infant* or a *Youth*, the matter whereof is very soft, and its *Pores* readily dilatable, if the *particles* of *Blood*, which are pusht out of the *Arteries* for the restoring of the solid *Parts*, be somewhat greater than those, into whose room they come, or if it happen that 2 or 3 *particles* crowd into one place, the *Body* by this means must needs grow and encrease.

VIII. *How the Parts of the Aliment become changed into Parts of our Body.*

But this apposition of Parts chiefly proceeds from the diversity of *Figures*, that is, as well in the several *Particles* of *Blood*, as in the *Pores* of the parts of the *Body*: for by this means it is, that when the *Blood* is driven into the Parts, some of the said *particles* are more fit to stop in these *Pores*, and others again in others; where being variously complicated and figured, they become immediately united with the *substance* of the *Parts*, and wholly changed into their nature: whereas those *particles*, which because of their peculiar *configuration*, are not fit to adhere or cleave to these or the other *Pores*, are driven further to others; till at last the residue of the *Blood*, whose *particles* were not adapted to enter any of the *Pores*, are remanded through the *Veins* to the *Heart*, there to be further digested, and to acquire a new *Aptitude* for their union with the several parts of the *Body*.

IX. *Blood, as Blood, doth not nourish.*

Yet we must not imagine that *Blood*, as it is *Blood*, doth nourish; for the *red particles* of *Blood* do not nourish our *Body*, but only the *Chylous parts* that are in it: for if the *Blood*, as such, did nourish our *Bodies*, then it must certainly perform this function to the *Heart* it self, and the *Lungs* which are so near to it; for the *Coronary Artery* of the *Heart*, as soon as it is got out from it, doth presently, by a retrograde motion, return to it again. Thus also in the *Lungs*, the *Blood* takes but a very short course. So that it cannot be otherwise, but that these 2 parts, must have the *Blood* dashing against them with more force, than it doth against any of the other parts of the *Body*: If therefore in any part *nutrition* were performed by the *Blood*

dropping out of the *Veſſels*, the ſame muſt ſurely happen here, ſeeing that the *Blood* hath more force to enter upon them, by opening the ſmall *Orifices* of the *Veſſels*. But we do not ſee it does ſo in either of theſe parts; for we find the *ſubſtance* of the *Heart* and *Lungs* in a natural and ſound ſtate, not moiſtned with extravaſated *Blood*, but with a certain clear moiſture.

Nay what is more, it is evident that the *Blood* never comes out of its *Veſſels*, without cauſing ſome Diſeaſe or other; for if this happens in the *Lungs*, it cauſeth the *ſpitting of Blood*, and if in other parts, *Swellings* and other *Diſeaſes*.

X. *The Chyle paſſeth through the Lacteal Veins, to the Subclavial.*

The *Phyſicians* of old were of opinion that the *Chyle*, being by the *Branches* of the *Vena Porta* ſuckt out of the *Stomach* and *Guts*, were by them carried to the *Liver*. But our Modern *Anatomiſts* demonſtrate that the *Chyle* is driven through the *Lacteal Veins* only to the *Subclavial*, and more particularly GASPER ASELLIUS, in the diſſection he made of a *Dog*, whom before he had ordered to be well fed, in the year 1622. which diſcovery hath been further improved by others, who have found that the *Lacteal Veins*, filled with a *Milky Juice*, are *Veſſels* different from the *Meſaraick Veins*: foraſmuch as in *Living Animals* they appear diſtinct from the *Meſaraicks* which are *Red*, if the diſſection be adminiſtred 4 hours after the *Animal* hath been fed, that is, at the time when the diſtribution of the *Chyle* is made; for after that time they diſappear again. But however tho' theſe be empty, they always appear like ſo many *Strings* or *Fibres*, and are never found fill'd with *Blood*.

XI. *The ſmalneſs of the Lacteal Veins, conduceth much to the forming of the Blood.*

Neither doth the ſmallneſs of the *Lacteal Veins* in the leaſt embarras this opinion, for this was deſigned ſo on purpoſe by the Provident Care of *Nature*, to prevent the more groſs and earthly parts of the *Chyle* from entring into them, as alſo that the *Chyle* through them might be, by degrees and leiſurely diſtributed according to the neceſſity or requirings of the *Body*, and the more eaſily changed into *Blood* in the *Heart*, by that new diſpoſition of parts it acquires by paſſing through it, and the Effervescence it undergoes there. For as the whiteneſs of *Snow*, and the colours of other *Bodies*, proceed only from the *contexture* and *Poſition* of the *Parts*: So the *Blood* derives its *Redneſs* only from that poſition of *parts*, which it obtains by its frequent paſſing through the *Heart*.

XII. *Why the Lacteal Veins are ſuppoſed to be of uſe for the Nouriſhing of the Body.*

The Reaſons that induce us to admit the uſe of the *Lacteal Veins* are; *Firſt*, Becauſe the *Chyle*, which is of a *White Colour*, cannot by the *Meſaraical Veins* be conveighed to the common *Ocean*, becauſe they are manifeſtly filled with the *Blood*; whereas the *Lacteal Veins* are *white*, that is, of the colour of the *Chyle* that paſſes through them. *2ly*. The *Lacteal Veins* do never appear till after the *Body* hath been *fed*, and only about the time when the *food* begins to be diſtributed; which is a ſtrong argument to perſwade us, that the *Chyle* paſſeth through them. *3ly*. The quantity of the *milky liquor* that is in theſe *Veins*, may be encreaſed, by preſſing the *Guts*, whilſt they are as yet full of *Chyle*.

XIII. *The paſſage of the Chyle from the Guts.*

The *Chyle* therefore being duly prepared, paſſeth through the *Guts*, where the *Alimentary Parts* are ſeparated from the unprofitable and excrementital, and thence run into the *Lacteal* or *Milky Veins*, which carry the ſaid Liquor into the *Common Receptacle*: From whence 2 other *Veſſels* convey it through the *Thorax* or *Cheſt*, near the *Backbone*, up to the *Subclavial branches* of the *Vena Cava*, and there empty themſelves.

XIV. *The Birth is not wholly nouriſhed in the Womb by the Mouth.*

Another Point to be examin'd is, how the *Birth* is nouriſhed in the *Mothers Womb*; ſince it cannot take in its *Food* wholly by the *Mouth*, but at firſt rather by *Appoſition*, and afterwards by the *Navel*. For the ſituation and diſpoſition of its *Parts* will not admit of this, ſeeing that the whole *Body* lies crouded together, and hath its *Mouth* ſhut up between its *Knees*. And tho' as ſoon as it is born, it reacheth to the *Mothers* or *Nurſes Breaſt*; yet is this only the effect of *Natures Providence*, which as it teacheth the *Birth* to fetch its *breath*; ſo likewiſe ſhe directs it, where to meet with *Food*.

XV. *But by the Umbilical Veſſels.*

But that the *Birth* receives its Nouriſhment by the *Navel*, may be proved from the *Courſes* of *Women*, which generally ceaſe in thoſe that are with *Child*, becauſe the *Blood* is then defrauded of the *Chyle* and its *Nutricious Juice*, which at that time is kept in the *Womb* for the Nouriſhment of the *Birth*. And for the ſame Reaſon, as ſoon as the *Birth* is born, the *Breaſts* are fill'd with *Milk*; becauſe the *Juice* which before was employed to feed the *Birth*, mounts up to the *Breaſts*, where it is changed into a *white Liquor*. And this is further confirmed by thoſe *Women* who do not *Suckle* their *Children*, for theſe perceive the *Milk* to return from the *Breaſt* to their *Womb*, where it is evacuated. To which may be added, that if the *Birth* in the *Womb* were nouriſhed by the *Mouth*, it ſeems that it ſhould alſo *breath*; which it is impoſſible it ſhould do, as long as it is in the *Womb*. Yea further, ſhould the *Infant* open his *Mouth* in the *Womb*, it would be in danger of being choaked with the *Liquor* wherein it ſwims. So that it is very probable, that the *Birth*, when it is perfected, is only, at leaſt chiefly nouriſhed by the *Umbilical Veſſels*.

XVI. *Fleſh is not the Natural Food of Man.*

Now foraſmuch as *Man* feeds on *Fleſh*, *Fiſh*, *Herbs* and *Fruits*, it may be enquir'd which of theſe is his moſt *Natural Food*. Indeed if we examine the matter ſtrictly, the feeding on *Fleſh* doth not ſeem Natural to him; yea, if we conſider the *Inſtruments* he makes uſe of in *Eating*, we ſhall find it contrary to the intent of *Nature*. For we find that thoſe *Animals* that feed upon *Fleſh*, as *Wolves*, *Lions*, and the like, have their *Fore-Teeth* long, ſharp, and at ſome diſtance from each other; becauſe *Fleſh* cannot well be prepared for the digeſtion in the *Stomach*, without ſuch *Inſtruments* as may pierce deep into the *Subſtance* of it, and pluck it to pieces. Whereas thoſe *Animals* that feed upon *Herbs*, as *Sheep*, *Oxen*, *Horſes*, *&c.* have ſhort *Teeth*, which are ranged cloſe together; whence it may be eaſily gueſs'd, that *Man* who is furniſh'd with ſuch like *Teeth*, was deſigned to feed chiefly on *Herbs* and *Fruits*.

XVII. *Children love Fruits more than Fleſh.*

This is further confirmed by the Example of *Children*, who following the Inſtinct of *Nature*, do prefer *Fruits* before *Fleſh*: For *Nature* not being as yet debauch'd in them, they manifeſt by their Choice, what *Food* ſhe deſign'd for them. So that it is not to be queſtion'd, but that if *Children*,

dren, as ſoon as they are weaned, ſhould be kept from the eating of *Fleſh*, they would the more ſtrongly deſire *Fruits*, and chooſe them before all other *Food* whatſoever.

XVIII. *The Eating of Fleſh was unknown to the firſt Men.* This Intent of *Nature* may further be illuſtrated from the Cuſtom of the firſt *Men* that lived in the *World*, who fed only upon *Fruits*. And accordingly the *Holy Scriptures* aſſure us, that the eating of *Fleſh* was not permitted till after the *Flood*. If it be Objected, that ſome *men* have been found in the *World*, that have fed upon *fleſh*, as the Savages of *Braſile*, *&c.* it may be eaſily anſwer'd, that theſe did not follow the guidance of *Nature*, but their own depraved Luſts and Affections, which prompted them not only to the eating of *Fleſh*, but even to the devouring of *Mans Fleſh*.

XIX. *Nature demonſtrates the ſame, by denying us Inſtruments neceſſary for the Eating of Fleſh.* Moreover, had *Nature* intended *Fleſh* to be our nouriſhment, ſhe would without doubt have furniſh'd us with *Inſtruments* fit for that purpoſe, nor have put us to the ſhift of making uſe of *Knives*, which other *Carnivorous Animals* do not ſtand in need of. Beſides, why have we ſuch an averſion to *Raw fleſh*, and cannot endure to taſte of it till it be prepared by *Fire*; but only to ſhew, that *Fleſh* is not our Natural *food*, being only introduc'd by *Luſt*, which hath quite changed our Nature from its Primigenial Inclination and Temper.

XX. *Man would be every whit as ſtrong, if he liv'd only on Herbs and Fruits.* Neither let any Man object here, That *Man* would be much weaker, if he ſhould confine himſelf to feed on *Herbs* and *Fruits* only; for we ſee that *Horſes* and *Bulls* are very ſtrong and hardy *Animals*, which yet feed upon nothing but *Herbs*, and *Corn* or *Pulſe*. How ſwift is a *Stag*, how lively vigorous and long Liv'd; and this only by feeding on the *Graſs of the Field?* So that I ſhould be eaſily induc'd to believe, that in caſe a *Man* were brought up like a *Beaſt* in the *Fields*, he would not be inferiour to *Stags* in running, nor to *Apes* in climbing of *Trees*; which his delicate and tender Education do now make him unfit for.

CHAP. VI.

How the Motion of the Heart, Arteries and Muſcles, are performed in the Body of Man.

I. *What the Heart, Arteries and Veins are.* WE may gather from what hath been ſaid, that the *Heart* is nothing elſe, but a *Body, conſiſting of Muſculous Fibres*, into whoſe *Subſtance* are inſerted *Arteries*, *Veins*, *Nerves*, and *Lymphatick Veſſels*. *An Artery is a Veſſel* or Pipe *proceeding from the Heart, fitted for the containing and conveying of Blood. A Vein is another ſort of a long and round Veſſel, hollow like a Pipe, with a ſingle and laſting Coat, woven together of all ſorts of Fibres.* There are 2 *Veins* which proceed from the *Heart*, and in their coming out from it ſeparate themſelves, and are called by ſeveral Names: The *Vena Cava*, or *Hollow Vein*, proceeding from the Right *Ventricle* of the *Heart*, and from thence mounting ſtrait to the *Brain*, is called the *Jugular Vein*, which under the *Armpits* divides it ſelf into 2 *branches*, called the *Axillary Veins*, or *Subclavial*; and going downwards, it becomes alſo divided, and ſends a large *branch* to the *Liver*; and this is the *Vena Porta*, ſo called, which being divided into very ſmall *branches*, loſeth it ſelf in the *Liver*. The other *Vein* being derived from the Left *Ventricle* of the *Heart*, is called *Pulmonalis*, or the *Lung-Vein*; becauſe it is diſtributed through the *Lungs*, the uſe of it being to convey the *Blood* back from the *Lungs*, by means of the Ear-lappet of the *Heart*, into the *Heart* again.

II. *All Motion in Man, doth not proceed from his Soul.* We pereceive many *motions* in the *Body* of *Man*, which the ignorant Common People do attribute to the *Soul*; for they ſeeing that a *Dead Body*, after the *Souls* departure, is deprived of all *motion*, conclude all *motion* to proceed from the *Soul*. But we ſhall eaſily be convinc'd of this Errour, by obſerving the Nature of *Flame*, which notwithſtanding that it is Inanimate, is in continual *motion*; even to that degree, as to exceed the agitation that is perceived in *Animated Bodies*.

III. *Heat is the Cauſe of all our Motions.* But not to concern our ſelves about the Opinions of the *Vulgar*, we conclude *Heat* to be the *Bodily Principle* of all our *motions*; ſeeing that *Death* is cauſed by nothing elſe, but the loſs of our *Native Heat*, or the deſtruction of ſome Principal part of our *Body*. Wherefore when the *Soul* becomes ſeparated from the *Body*, this doth not proceed from any defect of the *Soul*; but becauſe the *Heat* vaniſheth, or becauſe ſome of the *Organs* are deſtroy'd and ſpoil'd. For as long as we live, there is a *Heat*, or rather *Fire* in our *Hearts*; but ſuch a one as is without Light, (and not much unlike to that whereby new *Wine* grows hot and ferments) which we make the *Principle* of all the *motions* that are in the *Body*.

IV. *Of the Parts of the Heart.* There be 2 *Ventricles* in the *Heart* F F, to which 4 *Pipes* or *Channels* do anſwer: To the Right *Ventricle* G G, the *Vena Cava* A B anſwers, into which all the other *Veins* empty themſelves, as into their common *Receptacle*; and the *Arterial Vein* D, which proceeding from the *Heart*, divides it ſelf into divers *branches* in the *Lungs*. To the Left *Ventricle* H H, as many *Channels* do belong, *viz.* the *Venal Artery* E, which riſeth from the *Lungs*, and the *Great Artery* called alſo *Aorta* C; which being derived from the *Heart*, doth divide it ſelf into many *Rivulets*, throughout the whole *Body*. Figure 62.

V. *The Blood runs throughout the whole Body.* They who are acquainted with the *Works* of Dr. HARVEY, know that the *Blood* runs out of the *Vena Cava* A B, into the Right *Ventricle* of the *Heart* G G, and from thence is carried to the *Lungs* through the *Arterial Vein* D; and afterwards returns from the *Lungs* into the Left *Ventricle* of the *Heart* H H, through the *Venal Artery* E; and laſt of all, after theſe Circulations, is conveyed into the *Great Artery* C, which carries the *Blood* throughout the whole *Body*. Theſe things being explained thus in few words:

VI. *The Cauſe of the Motion of the Heart, is the Bloods dilatation.* I ſay, That the *motion* of the *Heart* proceeds from the *Dilatation* of the *Blood* that paſſeth through it; Which effect of *Dilatation* is to be aſcribed to the *Fire* which lies hid in the *Heart*, which rarefies the *Blood* as ſoon as it enters into the *Ventricle* of it; by which rarefaction and expanſion of the *Blood*, the Mouths of the *Veſſels* are opened, and the *Blood* is conveyed thence; upon which evacuation other *Blood* enters the *Heart*, to ſupply the place of that which is run out; which rarefying in like manner cauſes the

Heart

Heart to swell. And from this only proceeds the *motion* of the *Heart* and the *Pulse* or beating of the *Arteries*; which is as often repeated, as any fresh *Blood* enters into the *Ventricles* of the *Heart*.

VII. *There is more Heat in the Heart, than in any other part of the Body.* For we are to observe, that as long as an *Animal* lives, there is more *heat* in the *Heart*, than in any other part of the *Body*; as also that the Nature of the *Blood* is such, as that upon the least overheating, it becomes immediately dilated and rarefied, whence the motion of the *Heart* and the *Pulse* of the *Arteries* do proceed.

VIII. *How the Heart and Arteries are moved.* For the better understanding whereof, we are to observe that the *Pulse* or *Beating* of the *Arteries* is chiefly promoted by 11 *little Skins*, which like so many little *Floodgates* or *Doors*, do open and shut the *Orifices* of the 4 *Vessels* that answer to the 2 *Ventricles* of the *Heart*. For at the same moment that one of these *Pulses* ceaseth, and another is at hand, these *Valves* in the *Orifices* of the two *Arteries* are exactly shut, and those that are in the *Orifices* of the 2 *Veins* are opened; so that it cannot be otherwise, but that at the same time 2 parts of *Blood* must run out of these *Veins*, one into the one, and the other into the other *Ventricle* of the *Heart*. Whereupon these 2 portions of *Blood*, being both of them rarefied, and consequently taking up a greater Space, they shut the *Valves* that are in the *Orifices* of the 2 *Veins*, and so hinder any more *Blood* to fall down into the *Heart*; and at the same time do push against and open the *Valves* of the two *Arteries*, and swiftly rush into them, by which means both the *Heart*, and all the *Arteries* of the whole *Body* are blown up. But this rarefied *Blood* becomes presently condens'd again, or penetrates into other parts of the *Body*. And by this means the *Heart* and *Arteries* fall flat again, the *Valves* in the entrance of the 2 *Arteries* are shut up, and those that are in the *Orifices* of the 2 *Veins* are opened, and give passage to 2 other *portions* of *Blood*, which cause the *Heart* and *Arteries* to be blown up again.

IX. *The Heart and the Arteries beat at one and the same time.* Having thus discover'd the Cause of the *Pulse*, it may be easily conceiv'd that the *Heart* and *Arteries* must beat both together; for tho' *Blood* be a *fluid Body*, yet forasmuch as it is contained in the *Veins* and *Arteries*, it is to be consider'd as a *Continuous Body*. For as when one end of a *Continuous Body*, such as a *Stick* is, is moved, the other end is moved likewise, in the very same moment; in like manner a *fluid Body* that is contain'd in a *Pipe* or *Channel*, if any part of it be moved, the whole must needs be moved also: Which the *Boys* in their *play* do evidence, who whilst they push forwards the *Water* that is at one end of the *Spout*, they make it gush out at the other. Moreover, all the *Arteries* that are in the *Body* are continued and joyn'd together, and do all of them rise from the *Aorta*; so that upon the least determination of Motion that is impress upon this beginning of the *Arteries*, all of them must be made partakers of the same.

X. *The Animal Spirits derive their Original from this Cause.* From this *Dilatation* of the *Blood* in the *Heart*, the *Animal Spirits* take their Original. For seeing that the *Blood* is made of the *Chyle*, and that the *Chyle* is nothing else, but *a company of the more subtil Particles of the Aliment that have been dissolved in the Stomach, separated by means of the Orifices of the Lacteal Veins, and from thence carried to the Heart:* It cannot be question'd, but that the *Chyle* and *Blood*, by frequently passing through the *Heart*, must attain to that great degree of Subtilty, as to resemble the *Particles* of those *Bodies*, which the *Chymists*, after *fermentation*, and several digestions and cohobations, do *distill* into *Spirit*, and bring over the *Helm*. These *Spirits* move upwards towards the *Brain*, because the *Great Artery G*, by which the *Blood* is carried up out of the *Heart*, tends directly that way. But being in great quantity, and not all of them alike pure, the more Subtil of them only do enter the *Brain*. So that the *Animal Spirits are the purest portion of the Blood, subtilized by the heat of the Heart, and of that extream Swiftness, as to resemble the volatile Particles of Flame.* For the *Spirits* are in a continual agitation, and never cease from *Motion*.

XI. *What Parts a Muscle doth consist of.* Now in order to our understanding of the manner how our *Members* are moved, we are to take notice, that the *Nerves*, which are the *Conduits* of the *Spirits*, do proceed from the *Brain* and the *Pith of the Back-bone*, and end in many *strings* or *filaments*, which penetrate into the *fleshy part*, and help to constitute a *Muscle*: For these 2 Parts, *viz. Flesh* and *Nerves* do chiefly constitute the *Essence* of a *Muscle*. Which appears from hence, that many *Muscles* are found in the *Body*, in which nothing else is to be seen, besides the *Nerve* and the *Musculous flesh*; as the *Muscles* of the *Eyes*, *Forehead*, *Temples*, *Bladder*, *&c.*

XII. *What Muscles are, and how they come to be stretched, and swell.* The *Muscles* therefore *are parts of the Body, that are fastned to others more solid, consisting of a loose and porous Flesh, and of a Membran that surrounds them; which, when the Nerves do reach,* (to make use of the words of GALEN, *Lib.* 1. *de motu Musculorum, Cap.* 1.) *they become variously cut and divided, till at last being altogether scattered into thin and skinny Fibres, they are woven through the whole body of the Muscle, &c.* For the *Nerves* are no other than so many *Channels*, which convey the *Spirit*, and are endued with *Pores* and *Valves*, that open themselves towards the Cavity of the *Muscles*; so as that when once the *Spirit* is let in, they do hinder it from returning back again. It is necessary therefore, that the *Muscles* being blown up by the *Animal Spirits*, should be dilated in breadth, and contracted in length, and thus move the part to which they are fastned by way of Traction or Drawing.

XIII. *The Difference of Muscles, as to their Situation and Figure.* The *Muscles* which GALEN, calls the *Instruments of Motion*, are all of them alike; but differing in *quantity*, *situation*, and *figure*. With respect to their Dimension some are *Thick*, as the 2 that are called *Vast ones*; others *Thin*, as the slender *Muscle* that bends the *Leg* or *Shin-bone*. Some are *Long*, as the *strait Muscle* of the *Abdomen*, and the *Abductor* of the *Leg*; others *Short*, as the *Pyramidal Muscles* at the bottom of the *Abdomen*. Some *Broad*, as the oblique and transverse *Muscles* of the *Abdomen*; others *Narrow*, as the *Muscles* of the *Fingers* and *Toes*. As to their *situation*, some are on high, others below; some on the Right-hand, others on the Left, &c. As to their *figure*, some resemble a *Lizard*, others a *Thornback*, others a *Mouse*: Some are three-corner'd, some four, some five; others are Round, Pyramidal, and the like.

There

XIV. *The Parts whereof the Muscles do consist.*

There are 3 Parts commonly assigned to a *Muscle*, *the Head*, *Belly* and *Tail*: By the *Head* of the *Muscle*, *Anatomists* understands that end, towards which the Contraction tends. Most *Muscles* have but one *Head*, tho' there be some that have two, and others three. By the Name of the *Tail*, they understand that end of the *Muscle* which is inserted in the part that is to be moved. And by the *Belly* they denote the middle part of the *Muscle*, which appears more swell'd like unto *Flesh*. Some *Muscles* have but one *Belly*, others two; as the *Muscle* which shuts the lower *Jaw-bone*, and that of the Bone *Hyoides*, which are therefore called *Double-bellied Muscles*, as those that have three *Bellies* are called *Three-Bellied*.

XV. *A description of the Half Nervous Muscle.*

This may happen several ways, the *first* whereof is, when the *fleshy Fibres* of 2 *Muscles* do directly meet one another, and by this means form one *Tendon*; as it happens in the *Muscle* called *Semi-nervosus*, or *Half-sinewy*, which is represented by the *Figure*, in which the *fibres* of the 2 *Muscles* A B, and B C, meeting one another directly, do by this their meeting form one common *Tendon* E B.

Figure 63.

XVI. *The description of a two-headed Muscle.*

The *second* manner is, when the *Fibres* of 2 or more *Muscles*, meeting each other obliquely, confound their *Tendons*, and of 2 make 1; as it happens in the *Two-headed Muscle* of the *Arm*, as also in the *Deltoides*, which are represented by the *Figure*, wherein the *Fibres* of the 2 *Muscles* A B, and D C, do meet obliquely, and confounding their 2 *Tendons*, make one of it, *viz.* the *Tendon* E F.

Figure 64.

XVII. *The Muscle of the lower Jaw-bone.*

The *third* manner is, when the *Fibres* of two *Muscles* falling upon the two opposite sides of one common *Tendon*, continue parallel to each other; as it happens in the *Digastrick* or *Two-bellied Muscle*, which moves the *Lower Jaw-bone*, and which is represented by the *Figure*, in which the *Fibres* of the *Muscles* D C, and B A, falling upon the two opposite sides of the *Tendon* F E, continue in a Parellel position to each other.

Figure 65.

XVIII. *The Mathematical effect of a Muscle.*

There are some *modern Philosophers*, who endeavour to make out, that the effect of any *Muscle* is meerly *Mathematical*, and demonstrable from the *Principles* of that *Science*. For seeing that there is a threefold Dimension, *viz. Length*, *Breadth*, and *Depth*, and that the *figure* of a Muscle is terminated by these, it follows, that all *Muscles*, that lye upon the *Bones*, when they are contracted, do increase as much in *breadth* and *depth*, as they lose in *length*; that is, attain to a greater prominence of their *Bodily bulk*; whereas, when they are extended, they cover a greater part of the *Body*. Which they demonstrate thus: Let there be a *Parallelogram* A B C D, representing the *Two-headed Muscle* in its state of Extension, and the *Square* B E G F, equal to it, representing the said *Muscle* in its state of *Contraction*. They say, that the *Contracted Muscle* in the *second Figure*, is every whit as large as the *Extended Muscle* in the *first Figure*: And because the Square of the *Muscle* B E G F, is equal to the *Parallelogram* A B C D, therefore they infer, that the *surface* of the *Muscle* is the same in both of the *Positions*, and that the Part G D, changed into *breadth*, is proportion'd to the *Line* A D, which determines the *Local motion*.

Figure 66.

The *motion* therefore of our *Members* is owing to the *Muscles*, which is when some of them are *Contracted*, and others *Extended*; for no part of the *Body* can be reduc'd to a less *Extension*, but that at the same time it must draw up to it that part to which it is joyned. Now that one *Muscle* is rather *contracted* than another, proceeds from the Communication of *Spirits*. For that *Muscle* is contracted that hath most *Spirits*, as there are fewer *Spirits* in that which continues extended, and for this Reason appears longer and thinner.

XIX. *Our Members are moved by the help of the Muscles.*

When it is said, That the *Spirits* which proceed from the *Brain*, do assist the *motion* of the *Muscles*; this is not so to be understood, as if they alone were sufficient to perform this, but that they determine the *Spirits* that are contained in all the *Nerves* of our *Body*, to tend to one part, more than towards another; or because they open the *Orifices*, through which many other *Spirits* may flow to one part, and by blowing up the same contract it.

XX. *The Spirits that are contained in the Nerves, are assisting to the motion of the Muscles.*

From whence we may gather, That our *Soul* doth not immediately move our *Members*, but only direct the *Spirits* that flow from the *Heart*, through the *Brain* into the *Muscles*, and determine them to such and such *motions*. For the *Spirits* are indifferent of themselves, and may with the same facility be applied to several *Actions*. Wherefore all *motions* that are performed in us, without the command of our *Will*; as *Walking*, the *Concoction of our Food*, *Singing*, and other such like *Actions*, which are done without our advertence, are not performed by the *Soul*, but only proceed from the disposition of our *Organs*, and influence of the *Spirits*. So that all our *Actions*, our *Thoughts* only excepted, do agree with and resemble those that we see in *Brutes*, and have one and the same *Principle*.

XXI. *The Motions that are excited in us without our advertence, do not proceed from the Soul.*

CHAP. VII.

Of the Circulation of the Blood.

I. *How the Blood is carried throughout the whole Body.*

FRom what hath been now said, no small difficulty ariseth; *viz.* if the *Blood* flow out of the *Vena Cava* into the Right *Ventricle* of the *Heart*, and from thence into the *Arterial Vein*, and out of it into the *Venal Artery*, and thence into the Left Cavity of the *Heart*, until it rush out into the *Great Artery*; whence then shall we suppose, that such great store of *Blood* can be furnish'd? Or, how comes it to pass, that the rest of the *Veins* that empty themselves into the *Vena Cava*, are not exhausted? Or, that the *Arteries* are not over distended, into which the *Blood* from the *Heart* runs?

II. *The Veins and Arterits are like so many Rivulets in the Body.*

This Difficulty will disappear, if we consider that the *Veins* and *Arteries* are like so many *Rivulets* in our *Body*, in which the *Blood* runs along, beginning its *motion*, as hath been said, from the Right *Ventricle* of the *Heart*, and after various windings falling into the same again; so as that its *motion* is nothing else, but a continual *Circulation*. For the *Blood* which is contained in the *Arteries* and *Veins* of the whole *Body*, by turns continually rushing forth from the *Heart*, is driven along through the *Arteries* into the *Veins*, and out of them

them again returns into the *Vena Cava*, the Branches whereof are disperſed throughout the whole *Body*.

III. *The Contraction of the Arteries, promotes the motion of the Blood.*

The Spontaneous Contraction of the *Veſſels*, which are full of *Blood*, doth very much promote that vehement *force*, whereby the *Blood* from the *motion* of the *Heart*, is driven all along through the *Arteries* and *Veins*. For by means thereof, with the help of *Subtil matter*, which foreeth the narrow *Pores* of the *Fibres*, the ſides of the *Veſſels* come nearer together, by which means the *Liquor* contained in them is ſtill driven further, and runs with a greater Force, as coming from a larger Space which it hath near the *Heart*, into the narrower *Arteries*: According as we ſee it happens in a *Hogs-Bladder*, which being fill'd with the *Breath* that is blown into it, is no ſooner removed from the *Mouth*, but the Spontaneous Contraction of the Sides of the *Bladder* do drive out the greateſt part of the *Air*.

IV. *Reaſons proving the Circulation of the Blood.*

This *Circulation* was firſt diſcover'd by *Anatomiſts*, from the communication there is between the *Heart* and the *Lungs*. For they found there was the ſame quantity of *Blood* in the *Venal Artery*, as in the Left *Ventricle* of the *Heart*, which they concluded could not be ſo, except that the *Blood* were ſtrained through the *Arteries* into the *Veins*, not by the *Anaſtomoſes* or Inoculations of the *Arteries* and *Veins*, but by means of the *porous Subſtance* of the *ſolid Parts*. They obſerved alſo, that in the *Hearts* of *Fiſhes* which want *Lungs*, they could not find a Left *Ventricle*, becauſe there is no neceſſity in them to have the *Blood* transfuſed out of the *Heart* into the *Lungs*. But they clearly make out, that ſuch a *Circulation* is neceſſary in *Man*, as well to preſerve the *Heat* of his *Body*, as to the production of the ſeveral *Humours* thereof. For how could it be otherwiſe, but that the outward parts of the *Body* muſt be congealed with *Cold*, if *New Blood* did not continually come to them, communicating the *heat* it brings along with it from the *Heart*? For conceive we the *heat* that is in the *Heart* to be never ſo great, yet would it not be ſufficient to warm the *Members* that are ſo remote from it, except *freſh Blood* did continually flow to them, to repair their loſt *heat*. Yea, it could not be otherwiſe, but that the *Blood* which is *cold* of its own Nature, muſt needs *ſtagnate* and be *coagulated* in the Parts, in caſe it did not continually return to the *Heart*, there to recruit its *heat*, and borrow *new Spirits*.

V. *Nutrition cannot be performed, without the Circulation of the Blood.*

Moreover, how could our *Bodies* be nouriſhed, if the *Blood* did not continually flow to all the *Parts* of it? And except ſome *Particles* of the *Blood* paſſing through the ends of the *Arteries* became joyned to the *Body*, entring into the place of thoſe which they juſtle out? How otherwiſe could our *Food* be digeſted in our *Stomachs*, and turned into *Chyle*, if there were not a virtue in our *Stomachs* proceeding from the *Heart* through the *Arteries*, which did promote their diſſolution? Moreover, all theſe Particulars may be confirmed from what before hath been ſaid, concerning the Production of the *Spirits*, which being the moſt Subtil parts of the *Blood*, mount from the *Heart* to the *Brain* through the *Great Artery*, and being afterwards diffus'd into the *Muſcles* by the help of the *Nerves*, impart *motion* to the *Body*. Which Sallies of the *Spirits* could not be, if the *Great Artery* did not by a Right *Line* aſcend from the *Heart* to the *Brain*.

VI. *The Common Practice of Chyrurgeons, is a confirmation of the Bloods Circulation.*

To this alſo may be added the Practice of *Chirurgeons*, who when they go about to let any one *Blood*, make a Ligature about the *Arm*, above the *Orifices* of the *Vein*, towards the *Shoulder*, that the *Blood* may guſh forth more freely; becauſe the *Ligature* hinders the paſſage of the *Blood*, and doth not ſuffer it to paſs beyond the *Ligature*: For tho' it cannot hinder the *Blood* from continuing its courſe, yet it cannot hinder but that freſh *Blood* ſtill comes out of the *Artery* to the *Hand*, and from the *Hand* to the opening of the *Vein*; becauſe the *Arteries* lye under the *Veins*, and by reaſon of the Hardneſs of their *Coats*, cannot be compreſt without great Force. To which may be alſo added, that the *Blood* which proceeds from the *Heart*, through the *Arteries*, doth ruſh with greater force towards the *Hand*, than it returns from the *Hand* through the *Veins* to the *Heart*; becauſe the *Blood* flows more ſlowly in the *Veins*, than in the *Arteries*; foraſmuch as that which is in the *Arteries* hath but very lately been heated and rarefied in the *Heart*, whereas that which runs in the *Veins*, doth in time grow cold, and conſequently moves more ſlowly.

VII. *As in the World there is a continual motion of the Water; ſo in Man, of his Blood.*

In like manner therefore, as there is in the Greater *World* a continual Courſe of the *Waters* that return from the *Sea* through *Subterranean Channels*; and of thoſe that run towards the *Sea*, by the *Rivers*: So in the *Little World*, *Man*, there is a perpetual *Circulation* of the *Blood* through the *Arteries* and *Veins*. The *Arteries* carry the *Blood* from the *Heart* to the *Members*; and the *Veins* return the ſame *Blood* again from the *Members* to the *Heart*: So that *the Circulation of the Blood is* nothing elſe, but *the perpetual Motion of the ſame Liquor, paſſing from the Heart through the Arteries, and returning through the Veins to the Heart.*

VIII. *Why the Blood that is in the Veins, is unlike to that which is in the Arteries.*

You will Object, That if the *Blood* be *circulated* throughout the whole *Body* 100 or 200 times (as ſome ſuppoſe) through all the *Arteries* and *Veins* to the *Heart*, there ſeems to be no reaſon why the *Blood* that is in the *Veins*, ſhould be unlike to that which is in the *Arteries*; whereas we find it is ſo. For the *Arterial Blood* appears more lively and florid; whereas that of the *Veins* is more dull, and of a *blackiſh Colour*, which difference would not be, if the ſame *Blood* did run through the *Arteries* and *Veins*.

IX. *Anſwer.*

I Anſwer, That this difference of the *Blood* is, becauſe that *Blood*, which is contained in the *Arteries*, hath before paſſed through the *Heart*, and keeps the ſame Qualities which it hath got there. Whereas the *Blood* that is contained in the *Veins*, is not ſo pure, as containing beſides the *Blood*, which flows to them from the *Arteries*, another *Liquor*, communicated to them from the *Guts*. To which we may add, that the *Blood* is not ſo hot in the *Veins*, as in the *Arteries*; becauſe the *Veins* are at a greater diſtance from the *Heart*, than the *Arteries*, which only is ſufficient to make it very different from that which is in the *Veins*; becauſe nothing is ſo eaſily changed, as the *Blood* is: As is evident in that as ſoon as it is got out of the *Veins*, the *Air* immediately corrupts it, ſo that it degenerates into another *Subſtance*.

X. *Whether Agues do depend on the Motion of the Blood.*

It may be you'l Object in the *Second* place, that *Agues* only return at certain *days*; whereas ſuppoſing the continual *Circulation* of the *Blood*, they would

would recur more frequently, *viz.* as often as the *Blood* returns to the *Heart*.

XI. *Answer.* To which may be Answer'd, That the Matter of *Agues* is not lodged in the *Veins*, according to the Opinion of some *Physicians*, but in some *Cavities* of the *Body*; where it continues till it comes to *maturity*, and be made fit to be mingled with the *Blood*. And according as it doth sooner or later arrive to this Maturity, it causeth either a *Quotidian*, *Tertian*, or *Quartan Ague*: And irregular *Agues* happen, when the said *Matter*, shut up in these *Cavities*, doth too much distend it self, and by its dilatation opens the *Pores*, so that by this means it wholly or in great part evaporates: For the *Pores* being once open'd, it is a hard matter to shut them again, before that much Matter is got out by them.

XII. *How long the Circulation of the Blood lasts in the Body of Man.* But some or other, it may be, will enquire, how long this *Circulation* lasts?

I Answer, That this may in some sort be guest at from the *Quantity* of the *Blood*, which at every *Pulse* of the *Heart* flows into the *Great Artery*; and by determining the *Quantity of Blood* contained in the whole *Body*. For if we suppose that at every *Pulse* of the *Heart*, one Dram of *Blood* enters into the *Aorta*, out of the Left *Ventricle*, and do then take an exact account of the number of *Pulses*, we shall easily infer, that if these *Pulses* be 64 times repeated in one Minute (as it hath been observed in a *Man* of a middle Age and Temperament) there will be 3840 of them in one Hours time. Whence it follows, that every Day 92160 Drams of *Blood* pass through the *Ventricles* of the *Heart* in one Day, which added together make 700 Pounds of *Blood*. But since there is not so much *Blood* in the *Body of Man*, nor scarcely above 10 Pounds, we must conclude that the whole Mass of *Blood* circulates through the *Heart* 72 times every Day, and that consequently it passeth out of the *Heart* into the *Arteries*, and from the *Arteries* to all the Parts of the *Body* thrice in one Hours time.

XIII. *How the Blood Circulates in the Birth, whilst it is yet shut up in the Womb.* It remains now, that we explain how that the *Circulation* of the *Blood* through the *Heart* is performed in the *Birth*, whilst it is shut up in the *Womb*: For seeing that the *Infant* doth not breath in the *Womb*, as shall be said in the next *Chapter*, its *Lungs* lye still without motion, and consequently admit no *Blood* at all. There are therefore 2 *branches* found in the *Birth*, by means whereof this Defect is made up: The *former* whereof springeth from the *Vena Cava*, 2 or 3 *Fingers* breadth above the *Midriff*, and is inserted into the *Vein* of the *Lungs* near the Left *Ventricle* of the *Heart*, which the *Blood* presently enters, and after its *Fermentation*, or Effervescence there, is through the *Aorta* distributed throughout the whole *Body*; but the remaining portion thereof ascends farther through the *Vena Cava*, and enters the Right *Ventricle* of the *Heart*; from whence, after *Fermentation*, it proceeds into the *Artery of the Lungs*, out of which, near to its egress out of the *Heart*, another small *Channel* ariseth, which runs strait to the *Great Artery*, and into it pours forth the *Blood* that comes from the Right *Ventricle* of the *Heart*, to the end it may be distributed throughout the whole *Body*. So that because the *Blood* cannot pass through the *Lungs*, therefore that which enters the Left *Ventricle* of the *Heart*, passeth into the Right; and thus by these *Channels*, the want of the passage through the *Lungs*, is made up. But after that the *Child* is born, these *Channels* are stopt up, as being of no further use; the *Circulation* of the *Blood* being now performed through the midst of the *Lungs*.

CHAP. VIII.

Concerning Respiration.

I. *What Respiration is, and that it is necessary for the maintenance of Life.* FOrasmuch as the *Life* of *Man* consists in the continual *Motion* of the *Blood*, and an *Animal* is said to *live* as long as the *Alimentary Juice* runs through the *Heart*, and from thence is driven to the other Parts; it is apparent that *Respiration* is necessary for the maintaining thereof, without which neither the *Beating* of the *Heart*, nor the *flowing* of the *Blood* can be performed. Hence it is that we commonly use the word *Expiring* for *Dying*; and that ARISTOTLE declares, that *the Life of Man consists in the drawing and breathing out of the Spirit.* For seeing that the *Heart* is heated by continual *motion*, *Respiration* is necessary for the *Ventilating* thereof, and for the Cooling of the *Blood*, to prevent it from being over-heated or enflam'd. *Respiration* therefore *is the Alternative Expansion and Contraction of the Thorax or Chest, by which the Air is conveyed through the Wind-pipe to the Lungs, as well to cool the Blood contained in the Veins thereof, as afterwards to expel the said Air, together with the smutty Vapours*: The *Chest*, *Midriff*, and *Abdomen*, as so many *Muscles* assisting to this Motion.

II. *Respiration is either Voluntary or Spontaneous.* *Respiration* is twofold, Voluntary or Spontaneous: *Voluntary* is that whereby the *Soul*, by its *Cogitation* and *Will*, determining the *motion* of the *Animal Spirits* into the *Muscles*, which serve for *Respiration* and *Expiration*, doth by turns enlarge and contract the *Breast*. *Spontaneous Respiration* is that which is performed by us when we are *asleep*, or think of something else, from the conformation of the *Nerves*, which assist *Respiration*; whereby the *Animal Spirits*, without any determination of our *Thoughts*, flow into the *Muscles*, design'd for *Inspiration* and *Expiration*.

III. *There be two parts of Respiration.* There be 2 Parts that constitute *Respiration*, *viz.* Inspiration and *Expiration*. *Inspiration is that Action, whereby the Chest becomes dilated upon the entrance of the Air: Expiration is that Action, whereby the Thorax*, or Chest, *becomes compressed upon the Expulsion of the Air, together with the Vapours.* So that the *Breast* derives its *Dilatation* and *Contraction* from this twofold Motion; its *Dilatation*, when its Parts are extended beyond its Natural amplitude; and its *Contraction*, when of themselves they return to their former Natural situation.

IV. *The Air doth not not enter the Breast to avoid a Vacuum.* When the *Air* enters the *Breast* in *Respiration*, this Motion doth not proceed from the fear of admitting a *Vacuum*, neither must we imagine, that the *Air* of it self runs thither without being driven; but forasmuch as by the *Dilatation* of the *Breast*, the *Air* which is about the *Breast* and the *Abdomen*, is easily thrust out of its place, because of its *Fluidity*; neither is there any other place to receive that *Air*, but that which is made for it

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by the *Dilatation* of the *Breast*; by this means it comes to pass that the *Air* which is driven away by the *Breast*, doth push forwards that which is about the *Mouth* and *Nostrils*, and drives it down the *Wind-pipe* into the *Lungs*. And thus as much *Air* is driven into the *Lungs*, as the *Breast* and *Abdomen* by their *Dilatation* do thrust away from them; so that here must be conceived a whole Circle of moved *Bodies*, according to that *Axiom* of *Natural Philosophy*, that *Every Motion is performed Circularly*. Now that the *Air* enters into the *Lungs*, because it is driven away by the *Breast*, is manifest in a *Dead Body*, where tho' the *Mouth* and *Nostrils* be open; yet the *breath* doth not enter into the Hollow of the *Breast*, because there is no Cause by which the *Air* might be driven thither. And the same we our selves experience, when after having breath'd out the *Air*, we keep our *Chest* for some Moments contracted: For in this state we are very sensible that the *Air* doth not in the least press upon us to enter into our *Lungs*, as long as we keep our *Breasts* in that posture.

V. *Respiration is performed by the help of the Muscles of the Chest, and the Abdomen.*

Respiration therefore is performed by the *Action* of the *Muscles* of the *Chest* and the *Abdomen*, which by extending and contracting of our *Body*, determine the *Air* to its *Ingress* and *Egress*. For there be 2 *Muscles* H and L, which by turns are blown up by the *Animal Spirits*, and fall again, and which by their Ingress and Egress do continually maintain the *Dilatation* and *Contraction* of the *Lungs*: For they are so disposed, as that when the one of them, *viz.* H is blown up or swells, the Space wherein the *Lungs* are contained, becomes dilated, whereupon the *Air* enters into them through the *Mouth* and *Nostrils*; and whilst the other L swells, the said Space is compress't, and then the *Air* is thrust out by the same ways: In like manner as the *Air* enters into a pair of *Bellows*, when the sides thereof are distended, and upon their being closed, is driven out again.

Figure 67.

VI. *The manner how Spontaneous Respiration is excited at first.*

The *Animal Spirits* therefore being conveyed out of the *Ventricles* of the *Brain*, through the interposited *Pith* of the *Back-bone* into 2 *Nerves*, through the *Valves* C D, are sent in more abundance, and with greater force into the *Nerve* C G A, which serves for *Inspiration*; forasmuch as the same is supposed to be more large and open. And thus the *Valve* or *Flap* G, being in the midst of both *Nerves* is shut, and hinders the *Animal Spirits* from removing out of the *Muscle* H, into another passage *K*; and at the same time the other *Valve* F, of the opposite *Nerve* D F B, is opened, by which the *Spirits* pass out of the *Muscle* L, into the *Muscle* H; which together with those which flow from the *Brain* into the *Nerve* C G A, do enlarge the *Body*, and drive the neighbouring *Air* into the *Lungs*.

VII. *The Reason of Spontaneous Expiration.*

And thus is *Respiration* performed, and lasts as long as the *Muscle* H, being swell'd by the affluence of *Animal Spirits*, doth hinder the Ingress of other *Spirits*, and being straitned by the *Membran* 1,2,3, wherewith it is covered, as well as by its Spontaneous Contraction, is compress't to that degree, that the *Animal Spirits* rushing forth, by reason of their too great quantity, out of that *Muscle*, do open the *Valve* G, and passing through it into the *Muscle*, they together with other *Spirits* flowing from the *Brain* dilate it, and streightning the *Breast* expel the *Air* out of it. And after this manner it is, that Spontaneous *Respiration* and *Expiration* is performed in us, either when we are asleep or awake.

VIII. *The Midriff is the Primary Cause of the Motion of Respiration.*

But forasmuch as the *Lungs* have neither *Fibres* nor *Muscles*, without which no part of the *Body* is moved, we are to enquire what that is which effects this *Rising* and *Falling* of the *Lungs*. For as a pair of *Bellows* is distended or compress't with the *Hand*; so a like Cause must be assigned, which dilates and compresseth the *Lungs*. This upon Enquiry we shall find to be the *Midriff*. For it is a thing whereof every one is aware, when he feels that *motion* whereby his whole *Abdomen* is lifted up at every *Inspiration*, that at an equal Interval of time, the *Gristles* of his *Ribs* are drawn inwards; because the *Midriff*, by its middle part, presseth the *Stomach* and *Guts* downwards, and at the same time doth attract or draw inward, the *Gristles* to which its Extream parts are fastned, by reason of the *tension* or stretching of its Middle part. Moreover we find, that when we have fed plentifully, our *Respiration* is more swift, but withal not so strong and vigorous: And the same thing we Experience, when the *Air* we take in is thick and fill'd with gross *Vapours*. Forasmuch as in the former case, the *Midriff*, because of the over-fulness of the *Stomach*, cannot dilate it self, as it was wont to do, and therefore endeavours to compensate the diminution of this *Dilatation*, by the frequency of her *Respirations*. And in the latter case, the *Lungs* are so clog'd with the gross *Air* they have drawn in, that not being able to cast it out again, they are forc'd to continue distended; and so it happens that the *Midriff*, not being able to return to its first State, is put upon a more frequent *Reciprocation* of its Motion.

IX. *Wounds in the Chest prove the great influence the Midriff hath on Respiration.*

This may be further confirm'd from *Wounds* of the *Chest*: For as soon as that is pierced, immediately the *Lungs* fall flat, the *Midriff* still continuing its *motion* upwards and downwards, and attracting the *Gristles*, and moving them, as it did before the said *Wound* was inflicted. So that we cannot say, that the *Lungs* do perform the Function of *Respiration*, but that they are only as Concomitants, inasmuch as complying with, or following the *motion* of the *Midriff*, they take in the *Air*, and presently after being contracted, expel the same, together with the smutty *Vapours* that arise from the *Blood*. Yea, it hath often been observ'd, that some Men who have had their *Lungs* in a manner wholly consumed, yet have never been troubled with any considerable difficulty of *Breathing*; which could never have been, in case the *Lungs* were the principal and primary *Instrument* of *Respiration*.

X. *Of the manifold use of Respiration.*

Many are the Uses of *Respiration*: *First*, For the *Cooling* of the *Blood*; for except the *Blood* that flows from the Right *Ventricle* of the *Heart*, through the *Arterial Vein*, be refrigerated by the *Air* taken in by *Respiration*, and be condensed again, before it enters the Left *Ventricle* of the *Heart*, it cannot be fit Fewel to that *Fire* which lies hid in the *Heart*, nor maintain it.

The *Second* use is, That the *Air* which goes out from the *Heart*, carries along with it some *Particles*, which are as it were the *Smoak* and *Soot* of the *Blood*, and conveys the same through the

the *Arterial Vein*, from the Right *Ventricle* of the *Heart*. For the *Lungs* are as it were a *Sieve*, by the help whereof the *Filth* is separated, and those *Humours* sent away which would choak the *Heart*, should they continue mingled with the *Blood*. *Respiration* therefore clears and purifies the *Blood*, that it may be fit to enter the Left *Ventricle* of the *Heart*, and without hindrance be transmitted to the *Aorta*. Wherefore *Respiration* is of absolute Necessity to the *Life of Man*, so that when that is stopt or hindred he must *dye*. And therefore HIPPOCRATES saith: *We may live for some days without Meat or Drink; but when once the passages of our Breath are stopt, we cannot continue one Hour. Moreover, when all other Actions admit Intervals of Rest, Respiration alone is that Action which in Animals never ceaseth.* For seeing that the *Animal Life* chiefly consists in the *motion* of the *Blood*, or at least necessarily depends on the same it is evident that upon the ceasing of *Respiration*, the *Blood* cannot pass from the Right to the Left *Ventricle* of the *Heart*; whereupon the *motion* of the *Blood*, which is of such absolute necessity to the maintaining of *Life*, must cease likewise.

XI. *How Infants Breath in their Mothers Womb.*

If you Object here, That *Infants* live in their *Mothers Womb* without *Respiration*: I Answer, That *Nature* hath taken another way to secure the *Life* of the *Infant* in his *Mothers Womb*, by taking care that the *Blood* which hath been *heated* and rarefied in the *Heart*, should not any more return thither again, but in a very small quantity. For since the passage of the *Lungs*, because of their compact consistence, is intercepted or shut up, the *Blood* is conveyed another way, out of the Right *Ventricle* of the *Heart* into the Left, *viz.* through the *Body* of the *Vena Cava*, out of which there is a passage opened into the *Venal Artery*, which is commonly call'd the *Oval Hole*; and another out of the *Arterial Vein*, into the *Great Artery*; through which Passages the *Blood* is forced to take its course. But as soon as the *Infant* is *born*, the *Blood* enters through the *Artery* and *Vein* of the *Lungs*, either because these *Vessels* of the *Lungs* are wider than those other *Passages*, and afford it a more free Ingress; or because the Passage of the *Oval Hole*, and the *Arterial Channel*, begin to be obstructed by degrees, and turn to a *Ligament*.

XII. *Some Animals live in the Waters, without any Respiration.*

And for the same Cause it seems, that *Ducks*, *Didappers*, *Geese*, and other *Aquatick Animals*, do live for some time under *Water*, without *Respiration*; because those *Passages*, I have but now mentioned, are not wholly stopt up in them, but either by their daily using of them, or by reason of the Natural *disposition of the Parts* in those *Animals*, do continue open, and cannot without some difficulty be obstructed or abolished. And we may with great probability attribute to the same Cause what *Historians* relate of some *Divers*, that would continue for *Hours* together under the *Water*, *viz.* that by a singular *Priviledge* of *Nature*, these two Passages continued open in them, so as that the *Blood* could pass through them, as it did before they were born. Yea, we have the Relation of some dissected *Bodies*, in which these have been found open, so as that the *Blood* could freely pass through them.

CHAP. IX.

Of the Growth and Decrease of the Body of Man; of the Temperaments and the Differences of Age.

I. *How Augmentation or Growth differs from Nutrition.*

A *Body* is said to be nourished, when the *Particles* of *Aliment* being turned into *Chyle*, do preserve and maintain it in the same state wherein it is; but it is said to grow, when these *Particles* are in such abundance joyned to it, as that thereby its *bulk* increaseth. Thus *Mans Body* is said to grow, when *Particles* of a *new Substance* are added to those which before made up its *bulk* or *magnitude*, exceeding in quantity what it loseth by continual *Transpiration*. For seeing that all the Parts of our *Body*, the *Bones* only excepted, are soft, their *Pores* consequently are easily dilatable; and therefore whensoever more prepared *Aliment* is joyned to them, than their Narrowness can contain, consequently that *Body* must increase in *bulk*.

II. *How Augmentation is performed in Mans Body.*

How this is done we shall easily understand, by following the *Blood* from its *Fountain*, the *Heart*, and observing the several turnings it takes in the *Body*. Conceive we therefore the *Blood* that hath been rarefied with the *Heat*, or *Fire* that is in the *Heart*, rushing forth thence through the *Aorta* towards the *Brain*, and some small portion of it entring the *Capillary Arteries*, and insinuating it self into all the infinite *Pores* of their *Membrans*, which are opened at every *Pulse* or beating of the *Heart*. Conceive we also these *Pores*, to be so exceeding narrow, that the *Particles* of *Blood* cannot range up and down in them, but are forced to pass strait forwards, so that touching one another, they do no longer compose a *Liquid Body*, but rather several slender *Threads*; such as the *Fibres* or Strings of *Flesh* are. This supposed, we shall easily apprehend that a *Body* is then said to be *Nourished*, when the dissipation of one *Fibre* of the *Fleshy parts*, is made good by an equal portion of *Matter*; and to *grow* or *increase*, when more Matter is joyned to it, than was dissipated. As we see that *Bread* swells to a greater bulk, when its *Pores* take in more *Milk* or *Wine*, than the quantity of *Air* was, which either of these *Bodies* have driven out of them.

III. *What Decrease or Diminution of the Body is.*

The Decrease or Diminution of the *Body*, is caused either upon the defect of *Food*, or when the *Aliment* is unfit to enter the *Pores*; or when the *Natural heat* is too weak to drive the *Food* to the ends of the *Fibres*, and by this means restore the dissipated Substance of the *Body*; as it happens in *Old Men*: Or when the *Heat* is too strong, as in those that are of a *Cholerick Complexion*: Or when the *Texture* of the *Body* is such, as that it cannot admit the *Alimental Juice* into its *Pores*.

IV. *The Body of Man grows till the Age of One and twenty.*

The *Body* of *Man* is observ'd to grow till the years of 21 or 22; for seeing that until that term, the *Bones* are not yet arrived to their utmost degree of Hardness, and that the other parts of the *Body* are readily penetrable, the *Aliment* accordingly is readily received into the *Pores* of them; and though for many years after this, the *Body* may spread in *breadth*, yet at last it ceaseth from any further growth, because the *Parts* of the *Body*, by reason of a continual access of fresh

Aliment grow ſo *hard* in proceſs of time, that its *Pores* can no longer be extended or dilated, nor any thing further be added to it.

V. *The Four Temperaments or Complexions of a Human Body.*

The *Body* of *Man* being a compound of different parts, *Phyſicians* have attributed to it a *Temperament* conſiſting of ſeveral *Humours*, *viz.* *Blood*, *Phlegm*, *Choler* and *Melancholy*; which are diſtinguiſht by their native *qualities*. For the *Blood* in the *Veins* and *Arteries* is hot and moiſt; *Phlegm* cold and moiſt; *Choler* hot and dry; and *Melancholy* dry and cold. So that a *Man* whoſe *Temperament* is hot and moiſt, is eſteemed of a *Sanguine Complexion*; he that is of a hot and dry, *Cholorick*; and ſo of the reſt. For all *Men* are not of the ſame *Temperament*, but differ according to the Predominance of one or more of theſe *humours*, and accordingly are inclin'd to various *Paſſions* and *Inclinations*.

VI. *The Diſpoſition of thoſe that are of a Sanguine Complexion.*

Perſons of a *Sanguine Temperament*, have quick and lively *Bodies*, a *Ruddy Colour* in their *Faces*, they are little thoughtful or ſerious, but inclin'd to *Jeſting*, *Singing*, *Complaiſance* and all manner of *Merriment*; and much addicted to *Luſt* and *Pleaſure*. They have a great, full and moderate *Pulſe*; which makes *Youths* that abound with *Blood* to be *facetious*, good natur'd, plump and of a Ruddy Complexion, and ſubject to *Inflammations* and other Diſeaſes proceeding from a ſurplus of *Blood*.

VII. *The Temper of ſuch as are Cholerick.*

Cholerick Perſons, or ſuch in whom the *Gall* abounds, are of a hot and haſty *Temper*, and like Straw or Stubble do eaſily take *Fire*, and are ſuddenly kindled with *Anger* and *Indignation*, but do not keep their *Anger* long, being ſoon reconciled. They are much ſubject to *Tertian Agues*, the *Yellow Jaundiſe* and *Fluxes of the Belly*, theſe *Diſeaſes* proceeding from the Depravation of the *Gall*.

VIII. *The Melancholy Complexion.*

Thoſe of a *Melancholy Complexion* are not ſo readily provoked to *Anger*; but being once provoked, are not eaſily appeaſed. They have a ſmall and ſlow *Pulſe*, narrow *Veins*, and a ſad and dark *Aſpect*. The diſeaſes they are moſt ſubject to are *Schirrous Swellings*, *Quartan Agues*, the *Piles*, *Hypochondriacal Melancholy*, and other *Diſtempers* of the *Spleen*.

IX. *The Phlegmatick Complexion.*

Phlegmatick Perſons being of a cold and moiſt *Temperature*, are not troubled with any vehement *Paſſions*, neither are greatly moved about any outward things; and therefore are Slow, Sleepy, Lazy, and not at all inclin'd to be *Angry*: They are ſubject to daily *Phlegmatick Tumours*, *Winds* and the *Dropſie*.

X. *All the parts of the Body have their Peculiar Temperament.*

The *parts of the Body* alſo have their particular *Temperament*; for the *Heart* is the hotteſt of all other parts, as having in it a continual *Fire*, which is fed and maintained by the never-ceaſing *Afflux* of the *Blood*. The moſt moiſt part is the *Brain*, which the continual Defluxions proceeding from it, are a pregnant witneſs of, being cauſed by thoſe *Vapours*, which continually aſcending to the *Brain*, are there condenſed. The *Bones* are the moſt cold and dryeſt parts of the *Body*, foraſmuch as their *particles* are without all *motion*, and their *Pores* are only filled with *Air* or *Subtil Matter*.

XI. *Of the Different Ages of Man.*

The difference of the ſeveral *Ages* of *Mans Life* doth likewiſe depend on a variety of *Temperament*; and are more in *Man* than in other *Animals*. By the name of *Age* we underſtand ſuch a part of the *Life* of *Man*, wherein by reaſon of the mixture of *Heat* and *Cold* in his *Body* and their acting upon each other, the *Temperament* of it undergoes a ſenſible alteration. Theſe *Ages* are diſtinguiſht into *Childhood*, or the *Age of Stripling*, the *Age of Young Men*, *Manly Age*, and *Old Age*.

XII. *Of the Firſt Age, Childhood.*

The *Age* of *Childhood* in *Boys* reacheth to their 14*th* year, and in *Girls* to their 12*th*. The *Bodies* of *Children* are in a manner of an equal *Temperature* between *Heat* and *Moiſture*; for tho' the *Heat* and moiſture of their *Bodies* exceeds that of Men, yet they are ſaid to be *temperate*, as being ſuch as beſt agree with their ſtate. *BOYS* and *GIRLS* begin to breed *Teeth* when they are a year and an half old; and when they are about 7, change their firſt *Teeth* for new ones.

XIII. *The Second Age, Youth.*

The next *Age* is *Youth*, which extends to the 25*th* year. This *Age* is more *Temperate* than *Childhood*, as wherein the *Heat* doth not ſo much prey upon and diſſipate the *moiſture*, and the *moiſture* leſs clogs the *Heat*. *Youths* are moſt deſirous of *Liberty*, and accordingly as ſoon as they are got from under the Inſpection of their *Parents* and *Maſters*, they are apt to run into great *Exceſs*, by betaking themſelves to their *Luſts* and *Pleaſures*. As being perſuaded that they are now wholly at their own diſpoſe, and at full and abſolute liberty to do whatſoever they pleaſe.

XIV. *The Third Age, that of Young Men.*

Next to *Youth* follows that which is called the Age of *Young Men*, which reacheth from 25 to 35, and is the flouriſhing *Age* of *Man*, wherein *Heat* and *Drineſs* do predominate; the *watry* Humour being much waſted in the foregoing *years*, and the *Oily Particles* more intricately mixed together, do make the *Heat* ſtronger, and preſerve the *Animal Spirits* better. Accordingly *Young Men* are more *hot* than *Youths*, and violently carried to *Venery*. As to the Temper of their *minds* they are *Reſtleſs*, *Raſh* and precipitant in their *Judgment*, neglecting preſent good *things*, and reaching out to thoſe that are Future.

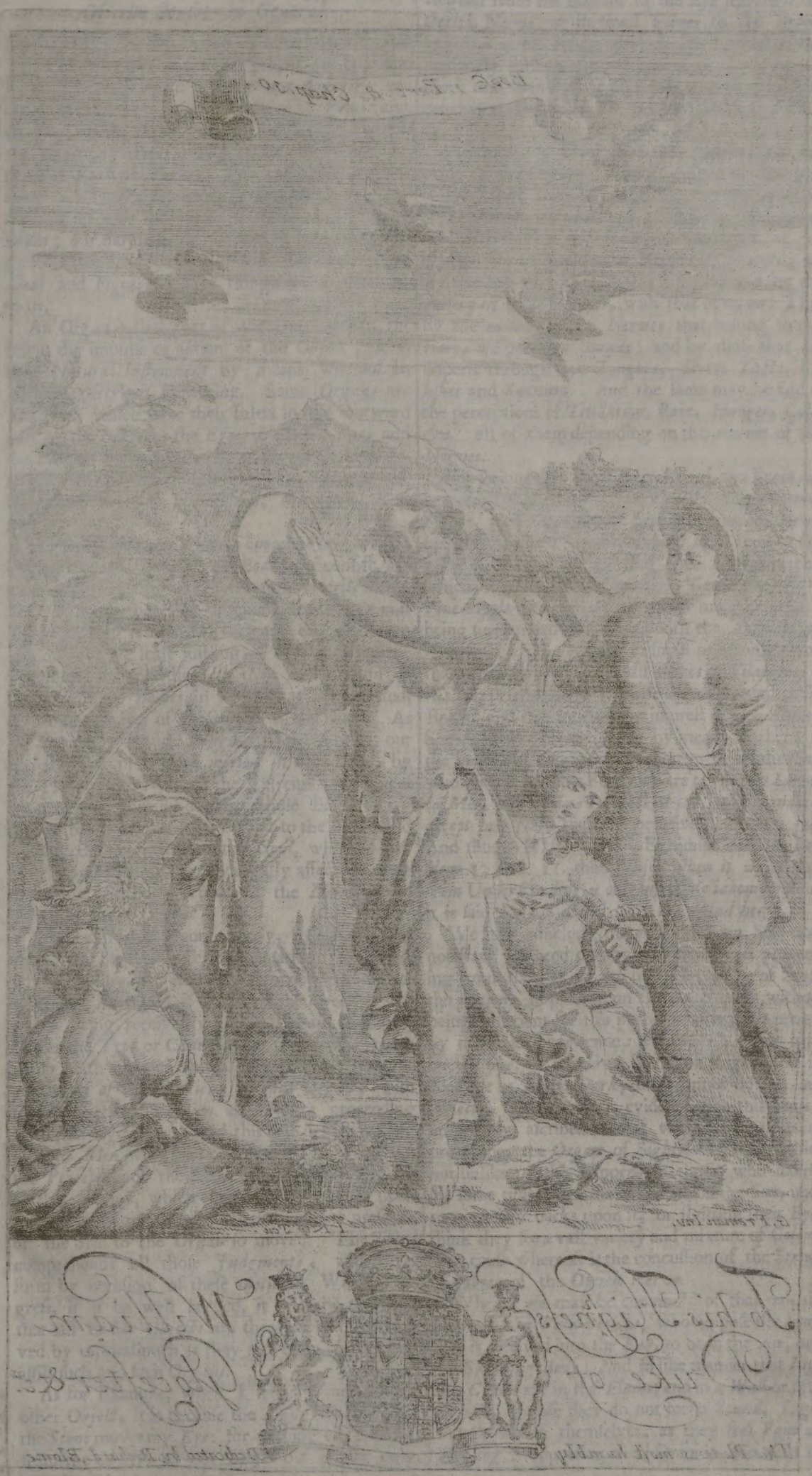
XV. *The Fourth is Manly Age.*

Next follows *Manly Age*, which from 35 extends it ſelf to 50. In this *Age* the *Natural Heat*, and Agitation of the *Spirits* begins to be leſſened; but yet the *Body* is not ſo exhauſted, as that the natural *Faculties* grow faint and weak, ſeeing that every part is ready and fit to exert the *Functions* and *Actions* of *Life*.

XVI. *The Fifth and Laſt is Old Age.*

Laſt of all comes *Old Age* which is Dry and Cold; the *former* part whereof called *Viridis* by the Learned, reacheth from the year 50 to 60, during which, many Old Men are yet pretty lively and vigorous; the *Middle* is from 60 to 70, during which term the *Spirits* are few and weak, and can but languidly perform their *functions*. The *Senſes* grow dull and weak, the ſtrength and vigor of the *Body* languiſheth. And the laſt is that which is called *Decrepit Age*, which compleating the Dryneſs and Coldneſs of the *Body*, brings in *Death*, the end and concluſion of them all.

CHAP.



G. Freman Inv. I. Kip Sou.

To his Highness William Duke of Glocester &c.ª

This Plate is most humbly Dedicated by Richard Blome.

CHAP. X.

Of the Senses in General.

I. *What the Senses are.*

THO' all things in the *Body* of *Man* be full of *wonder*, and most proper to raise our *minds* in Gratitude to Glorifie our *Creator*; yet doth nothing more lowdly proclaim his *Power* and *Goodness*, than the *variety* of our *Senses*, which are those *Affections* or *Cogitations* by which we perceive *External* Bodies. For the *Senses* are nothing else but *Perceptions of the Mind, that are the consequences of several Motions made in the* Brain; our nature being such, that by occasion of these *motions*, produced in our *Organs*, several *Ideas* and *Figures* of the things are represented to us.

II. *What an Organ is, and how manifold they are.*

An *Organ* is that part of the Body, which receives the impulse or action of the *Object*; or is that *Natural Instrument* by means whereof an *Animal* perceives something. Some *Organs* are *External*, which have their Inlets in the outward part of the Body, as the *Eyes*, *Nostrils*, *Ears* and the *Nerves* that are joined to them: Others *Internal*, which lie hid in the inward parts of the Body, as *the* Brain, *the Spirits*, *the Pineal Kernel.*

III. *How the Senses perform their Functions in the Body.*

For seeing that our whole *Skin* and *Flesh*, whereof the outward *Habit* of our Bodies do consist, are interwoven with several *Twigs* and *Tendrils* of the *Nerves*, when these are distended by the *Animal Spirits* rushing into them, they are easily put into motion by the least justling of outward Bodies: which *motions* according as they are grateful or hurtful to the Bodies in which they are excited, do exhibit variety of sensations to the *Soul*. As for Example, because *Tangible Objects* touch our Bodies, they produce a *motion* in the *Organ*, by the Help of the *Nerves*, the Extremities whereof are extended throughout the whole Body, which *motion* being immediately carried to the Brain, and thence communicated to the *Soul*, which is intimately present to it, doth variously affect the same according to the diversity of the *Nerves*, and structure of the *Organ.*

IV. *There be three Degrees of Sensation.*

This will appear more clearly, by considering these three degrees in every sensation: the *First* when the *Organ* is affected by forrein Bodies; or when the *Impression* is made by the *object* it self, which being received into the *Organ* of *Sense*, carries the *Type* or *Character* of the *sensible thing* along with it; and this is nothing else but *the Agitation of the Particles of that* Organ, with some variety of *Position* and *Figure* proceeding from that *Agitation.* And this first degree is common to *Men* with Brute Beasts. The *Second* is the *Perception* of the *Soul*, heeding or attending to that *motion*, which immediately follows upon the former degree, because of the intimate presence of the *Soul* to the *Organ* so moved. The *Third* comprehends all those *Judgments*, which we form by occasion of these *motions.* Which Progress, if it be well heeded, it will be manifest, that all Bodily *Objects* are therefore only perceived by us, forasmuch as they move the *Nerves* that assist such and such *Organs.*

V. *The Three Degrees of Sensation illustrated by an Example.*

As for Example, when I see a *Stone*, or any other *Object*, it is because the *Light* reflected from the *Stone* moves my *Eye*: for nothing else proceeds from the *Objects* to our *Senses* but *motion* only, or an *Impression.* Which *motion* is readily conveighed from the Bottom of the *Eye* through the *Optick Nerve*, or its small *Fibres* to the Brain, and *Seat of the Soul*; upon which impression immediately follows our perception of *Light* or *Colour*; and then the *Judgment* whereby the *Soul* concludes the thing to be of such and such a *Colour.*

VI. *The Diversity or Variety of our Senses, proceeds from the Difference of our Nerves.*

For from the variety of the *Motions* that are made in the *Organs*, and conveighed to that part of the Brain, from whence the *Nerves* proceed, divers *Senses* are produced. Thus by the force of the *motions* that are made in that part of our Brain, whence the *Optick Nerves* do proceed, we are affected with the *Sense* of *Light*, and by the variety of those *motions*, with that of *colour.* Thus by the *motion* of the *Nerves* that belong to our *Ears*, we perceive *Sounds*; and by those that are dispersed through our *Tongues*, divers *Tasts*, *Relishes* and *Savours.* And the same may be said of the perceptions of *Titillation*, *Pain*, *Hunger*, *Cold*, *&c.* all of them depending on the *motion* of the *Nerves.*

VII. *All Motions are conveighed to the Brain.*

For seeing that the *Ventricles* of the Brain are perpetually filled and distended by the *Animal Spirits*, as we see that the *Sails* of *Ships*, are blown up and stretched by the *wind*: And since in the midst of the Brain we find that *Kernel* placed, which is called by *Physicians*, *Conarion*, or the *Pine-Apple-like-kernel* (of which more hereafter) being surrounded every way with the *Animal Spirits*, there is no *agitation* so small or inconsiderable that can happen to the small *Fibres* or *Filaments* of the *Nerves*, but that it must be communicated to the Brain, and consequently be impress on the *Animal Spirits* contain'd in it; and by means of them to the foresaid *Kernel*, and consequently to the *Soul* whose Residence it is. For so we are taught by *Learned Men, that we never feel* or are sensible *indeed, except we feel*, that is, perceive, *that we feel.* And thus ARISTOTLE himself tells us *Problem* 33 *Sect.* 11. that *Sense, when it is separate from Understanding, is only insensible labour*, whence it is said that the *Mind sees, the Mind hears.*

VIII. *Our Senses are no more than Motions.*

We may conclude therefore that *our Soul* doth not stand in need of any sensible *Species* proceeding from the *Objects*, to make it capable of *Sense*, the *motions* impress upon the Body from without being sufficient for this purpose, as may be proved by manifold Experience: For when a *Man* is hit on the *Eye*, he perceives flashes of *Light*, tho' indeed he be in the *Dark*, and cannot discern any *Objects.* Whence it is evident, that this *Sense* is only to be ascribed to that violent *agitation* impress upon the *Organ* of *Sight.* And something not unlike to this happens to those, who having for some time fixed their *Eyes* upon the *Sun*, upon turning their backs upon it, or shutting their *Eyes*, think they see a vast variety and mixture of *Colours.* The cause whereof is the concussion of the *Strings* or *Fibres* of the *Optick Nerve.*

IX. *The Error of the* Peripateticks *about the Cause of Sense.*

Whence we may be convinc'd of that palpable Error of the *Peripateticks*, who suppose the *Sound* that is received into the *Ear*, to be in the *Air*, or in the *Sounding Body*: And in like manner, that *Light* and *Colour* are in the *Flame*, and in a *Wall* or other *Object*; because they do not feel a *Sound*, *Light*, and *Colours* in themselves, as they feel *Pain* and *Tickling*; supporting their Opinion also with this

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Argument, That the *Colours* that are seen, appear to us much bigger than our selves.

X. *This common Errour refuted.* But that these *Arguments* are of no force in this case will appear, if we consider, that we have a *sense* of many things which are without us, and which we judge to be much greater than we our selves are, tho' there be nothing without us that effects such *Sensations* in us. For *Mad-men*, and such as are in a high *Fever*, do sometimes see, or think they see many *Appearances* or *Representations*, which are not impresst upon their *Eyes* from without. In like manner it frequently happens when we are *asleep*, that we think we hear *Sounds*, or see *Colours*, after the same manner as we do when we are *awake*; and then attribute that *Sound*, and those *Colours*, to *External Objects*, and imagine them to be much greater than they are; when indeed there is nothing without us, to which we can attribute them.

XI. *There is no Necessity for our admitting of Intentional Species.* Neither is there any thing that obligeth us to admit such *Images* as these, for the Explication of the *Sense* of *Seeing*, or any other; since we find that there are many things that can produce *Affections* and Commotions in our *Souls*, which have no likeness at all with the *Objects* they signifie: As when *Words* spoken, or committed to *Paper*, represent the *Slaughter of Men*, *Destruction of Cities*, or *Storms at Sea*; or excite the *Affections* of *Love* or *Hatred*: Which Representations or Thoughts bear no resemblance at all with the things they signifie.

XII. *Because they are not Intelligible.* Besides these *Species* (which are commonly called *Intentional*) are so obscure, that the Nature of them cannot be understood: For they are not *Corporeal* or *Divisible*, seeing they are found whole and entire in every least part of the *Subject* or *Medium*. And if they be Indivisible, as most suppose them, and of an ambiguous Nature between *Body* and *Spirit*; how come they to move our *Senses*, yea, and sometimes hurt them too? Or how can they represent *Extended Beings*, being without *Extension* themselves?

XIII. *Neither is the Cause of them intelligible.* Neither is the *Original* or Cause of these *Images* less obscure, than they themselves are: For how can we suppose that *sluggish Bodies* can by Emanation send forth such excellent Forms? Nothing being more wonderful or inexplicable, than how such *Spiritual Forms* should continually be procreated by *Terrestrial Bodies*, or flow from them. Besides, by what *Chariots* or *Vehicles* are they conveyed to us? Do they come solitary to us from the *Object*? Or are they diffused and multiplied by *Propagation*, and that in a Moment of Time?

XIV. *The Senses are in the Soul.* Wherefore tho' every one (as *DES CARTES* saith, in the beginning of his *Treatise of Light*) be apt to persuade himself, that the *Idea's* which we have in our *Thoughts*, are like the *Objects* from whence they proceed; yet can I find no Reason, to assure my self thereof: But on the contrary do meet with many *Experiments*, that may make us to question it. For if *Words* that signifie nothing of themselves, but only from Custom and Human Institution, are sufficient to make us conceive many things, wherewith they bear no resemblance at all: Why may not *Nature* as well appoint a Sign, which may make us to have the *Sense of Light*; tho' indeed, it contain nothing that is like that *Sense*? Don't we find, that in this manner she hath appointed *Laughter* and *Tears*, whereby we may read *Joy* or *Sorrow* in the *Faces* of *Men*? But you'l say, That our *Ears* make us sensible of nothing but the *Sound* of *Words*, and that it is our *Soul* only which remembers what these *Words* signifie, that does represent the same signification unto us at the same time. To which I Reply, That it is our *Soul* also that represents to us the *Idea* of *Light*, as often as the Action which signifies the same, doth touch our *Eye*.

XV. *It cannot be conceived how these Images should reach the Brain.* Neither is it less difficult to explain, how these *Images* can flow from the *Objects*. For what *virtue* is there in them, to produce these *Species*? Or how shall they be received into the *Organs* of the *Outward Senses*, and from thence be conveyed through the *Nerves* to the *Brain*? If the *Species* be received by the *Sense*, how is it that it is not known or perceived by it, since every thing that represents ought to the *Knowing Faculty*, is objectively related to it, forasmuch as it supplies the room of the thing it represents?

XVI. *The Sense of Titillation or Pain, cannot be explained by Species.* None of these things were ever yet fully explained by those, who so much cry up Sensible *Species*; nor ever will be, as I suppose. Besides, how will they go about to explicate the *Sense* of *Pain* and *Tickling* by the help of these *Images*? The *Point* of a *Sword*, for Example, is thrust into a *Body*, which causeth a dissolution of *Parts*, whereupon *Pain* follows: Where shall we be able to find either in the *Sword*, or the Division of the *Body*, any *Species* that is in the least like the Sensation of *Pain*, that follows thereupon? What *Analogy* hath the application of our *Hand* with the *Sense* of *Titillation*? Conclude we therefore boldly, that *Pain*, and all other *Sensations*, are therefore excited in us; because the Parts of our *Body*, by the *Touch* or *contact* of another *Body*, are locally moved; which *motion* of the *Nerves*, if it be moderate produceth *Titillation*; but if violent, *Pain*.

XVII. *Light and Sound are Motions only.* Moreover, what is *Light*, but the *motion* of the *Subtil* and *Æthereal matter*, which shakes and agitates the little *Nerves* of the *Retina* or Net-work *membran* or *coat* of the *Eyes*? What is *Sound*, but the *motion* of the *Air*, which strikes the *Drum* or *Organ* of *Hearing*? Forasmuch therefore as divers *Objects* variously strike the *Organs*, it can be no otherwise, but that the *Soul*, which is placed in the middle of the *Brain*, must by means thereof perceive the differences of *Sensible things*: Somewhat in like manner as a *Blind-man*, by the motion of his *Stick*, can discern or distinguish a *Stone* from *Sand*, and *Earth* from *Water*. Because there is nothing, besides *Motion*, which can strike the *Organs* of the *Senses*, or affect the *Mind* it self.

XVIII. *Of the Five Senses.* *Sense* (by which word nothing else is understood, but a *Faculty* of perceiving *Sensible Objects*) is fivefold, *viz. Feeling*, *Tasting*, *Smelling*, *Hearing* and *Seeing*, according to the diversity of *Objects* that move the *Nerves* of the several *Organs*; and the variety of the *Organs* themselves, and the *modes* or manner of their being affected therewith. Which cannot but happen, if the *Organ* that is affected be sound and whole, with a sufficient distance of the *Object* from the *Organ*, and a fit *Medium*. By defect of the *first* of these, the *Sense* often mistakes in those that have the *Yellow Jaundies*, or *Agues*: For want of the *second*, the

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Object cannot be discerned, if it touch the *Organ*: And by failure of the *third*, the *Sight* that perceives *Objects* through a misty *Air*, or partly through the *Water*, and partly through the *Air*, is very apt to mistake the true Modifications of them.

XIX. *The Division of the Senses into Internal and External.*

The *Senses* are also commonly divided into Internal and External. The *Internal* are 2, *viz.* the *Common Sense* or *Phantasie*, and *Memory*. The *External* are the 5 already spoken of, and are called *External*, because they are produced in us by the help of outward *Organs*: Tho' indeed, if we will speak acurately, all these 5 *Senses*, called *External*, are *Internal*, forasmuch as it is the *Soul* alone, which residing in the *Brain*, *Sees*, *Hears*, *Tastes*, *&c.* It may also be said, that there is but one only *External Sense*, *viz.* that of *Feeling*; because no *Sense* can be without *Contact* and *Local motion*. Thus, if we would *taste* any thing, it is necessary that the *Food* should touch the *Nerves subservient to that Sense*, that so the said *motion* may be conveyed to the *Brain*, or the *Common Organ of Sense*; and the same may be said of all other *Senses*.

CHAP. XI.

That the Senses are an Effect of the Nerves; and that the Soul of Man only feels, forasmuch as it resides in the Brain.

I. *How the Nerves conduce to the forming of the Senses; and how the Soul rules in the Brain.*

THo' it sufficiently appears from the foregoing *Chapter* what *Sense* is, and how by the Ministry of the *Nerves* External *Objects* are communicated to us; yet it remains still for us to enquire, how the *Nerves* perform this; and why the *Senses* rather have their residence in the *Brain*, than in any other part of the *Body*. Both which, tho' they be different Points, I shall comprehend in this *Chapter*.

II. *Three things are to be consider'd in the Nerves.*

In the *first* place, we are to take notice, that the *Nerves are Vessels fitted for the containing and conveying of Spirits, proceeding from the Pith within the Brain*. *Secondly*, That there are 3 things to be considered of in the *Nerves*; *First*, The *thin Skins* wherein they are wrapt or cover'd, which proceeding from the *Coats* or *Membrans* that encompass the *Brain*, are dispersed throughout the *Body* into small branches like *Pipes*. *Secondly*, That their *Inward Substance*, which is divided into very fine *filaments* or *Strings*, do reach from the *Brain*, whence they take their rise, to the utmost Parts of the *Body*, with which these *Nervous filaments* are interwoven. *Lastly*, The *Animal Spirits*, which like a *Wind*, or most *subtil Air*, rushing through these little *Pipes*, do move the *Muscles*, by way of Inflation or blowing of them up. It remains now that we say something, how those *Strings* or *Capillaments* which are within the *Tubes* of the *Nerves*, are subservient to *Sensation*.

III. *How the Nerves are subservient to Sensation.*

Which will not be difficult to understand, if we suppose that these *Capillaments* do reach to the Extremities of all the *Members*, that are capable of any *sense*; so that if any part of those *Members*, to which the *Nerve* is fastned, be never so little stirr'd, at the same Moment that part of the *Brain* from whence that *Nerve* proceeds, must be moved also. Which we may Experience in a stretched-out *Rope*, whereof if the one end be touched, the other must be moved at the same time. So that all the diversity of Impressions that are made upon the *Brain*, do arise from the *Nerves*, which carry the various *Qualities* of the *Objects* along with them.

IV. *How the Body is excited from External Objects, to move it self.*

We must therefore imagine, that those small *Filaments* that are derived from the inmost Recesses of the *Brain*, and constitute the *Pith* or *Marrow* of the *Nerves*, are so disposed in all those Parts that are the *Organ* of any *Sense*, as that they may be most easily and readily moved by the *Objects* of those *Senses*. And that whensoever those *Filaments* are never so little moved, they draw those parts of the *Brain*, whence they proceed, and at the same time open the *Orifices* of some *Pores*, that are in the inward Surface of the *Brain*, through which the *Animal Spirits* in the *Ventricles* of the *Brain*, begin immediately to direct their course, and through them rush into the *Nerves* and *Muscles* that are the *Instruments* of those *Motions*, that are altogether like them that are excited in us, when our *Senses* are so and so affected.

V. *The Soul of Man hath its Residence in the Brain.*

As to the *second Particular*, *viz.* That the *Soul* of *Man* doth *feel*, that is, sensibly perceive all *things*; not as it is in the *Organs* of the *External Senses*, but only inasmuch as it is in the *Brain*, which is the *Center* and Rise of all the *Nerves*, this is evident from *Examples* and *Reason*. For when we see *Light*, or hear a *Sound*, we must not imagine that the *Soul* exerts this Act of *Sensation* in the *Eye* or the *Ear*; but that it perceives these things in its *own place* or seat, by means of the *Nerves* that reach from those parts to the *Brain*. For if the *Soul* did see in the *Eye*, and hear in the *Ear*, since both these *Organs* are double, there must needs follow a double perception of one and the same *Object*, at the same time: And since the contrary is most evident, it follows, that the *Soul* feels only in that part of the *Body* where the 2 *Impressions*, which proceed from one *Object*, through the double *Organs* of the *Senses*, are united again into one, before they affect the *Soul*.

VI. *Proved from the Experiment of Vapours and Wounds.*

This may be confirmed from manifold *Experiments*: For we find by daily Experience, that the *Vapours* which ascend from our *Stomach* to the *Brain*, and being condens'd there, do obstruct the *passages* through which the *Animal Spirits* have their course, do deprive a *Man* of the *Power* of *Sensation*. We find also that *Diseases*, which affect the *Brain*, or *Wounds* that are inflicted in it, do destroy the *Senses*; as is manifest in those that are struck with the *Apoplexy*. In like manner in *Frenzies*, wherein the *Imagination* is spoiled, Remedies are applied to the *Head*, which would be very foolishly done, if the *Senses* had their *Residence* in any other part of the *Body*. Hence it is that they who are seiz'd with the *Apoplexy*, are immediately deprived of all their *Senses*, so as not to be sensible, tho' they be flash'd with *Knives* or prick'd with *Pins*. And for the same Reason it is, that Persons that have their Attention fix'd upon any thing, do not take notice of things that are done in their presence; because the *Soul* residing in the *Brain*, is otherwise taken up, so as not to take notice of the things that ore offer'd unto it.

VII. *Another Instance taken from those, who are troubled with the Vertigo, or Turning of the Brain.*

But no more convincing *Argument* can be alledg'd to prove, that the *Soul* doth sensibly perceive in the midst of the *Brain*, than that which is taken from the *Vertigo*, in which all *External Objects* seem to move round; whereas indeed there is no such *motion*, neither in the *Objects* themselves, nor in the *Outward Senses*; but it proceeds only from the *Spirits* in the *Brain*, being so moved, which affecting the *Soul*, it rashly attributes the said *Circular motion* to the *Objects* that are about it.

VIII. *The same thing confirmed from the Pain that persons think they Feel in the part they have lost.*

Moreover, they that are earnestly busie about Serious Matters, or are wearied with long *Study*, are sensible of a *Pain* in their *Head*; which I my self, after a little Study, frequently Experience: Which would not be so, if the *Soul* had not its *Residence* in the *Brain*, and did imagine and feel there. Besides, it sometimes happens that *Pain* seems to be felt in that part which is cut off from the *Body*; according to what *DES CARTES* tells us of a *Girl* that had her *Arm* cut off, who afterwards complain'd of a *pain* she felt in her *Fingers*. Which could not proceed from any other Cause, but because the *Nerves*, which came from the *Brain* to the *Hand*, upon the cutting off of her *Arm*, reacht no further than her *Elbow*, where being affected after the same manner, as they used to be when her *Hand* was yet *pained*, made her suppose, that she felt the same *pain* she formerly felt in her *Fingers*. For such is the Nature of our *Body*, that no part of it can be moved by another, which is a little distant from it; but that it must be moved in like manner by those Parts that come between. As is manifest in a *Rope*, the End whereof may as well be pull'd or hal'd by that Part which is neareſt to the midst, as by the other End opposite to it.

IX. *When we have leaned long upon our Elbow, we find a Pain in our Little Finger.*

In like manner it sometimes happens, that after having leaned long upon our *Elbow*, we are sensible of a *Numness* in our *Little Finger*; because the *Nerve* which ends in that *Finger*, being too much prest upon, doth affect the *Organ* of the *Common Sense*, as if the *Finger* it self were so prest. For we are wont to affix the *Sense* of *Pain* to that part, which is wont to be moved by the *Objects*, and wherein the stretched *Fibres* of the *Nerves* are terminated.

X. *In what part of the Brain the Soul hath its Seat.*

Wherefore it is necessary, that the *Soul* have its Residence in that part of the *Brain*, to which the *Filaments* of our *Nerves* do reach; to the end that it may take care for the Security of all the parts of the *Body*, and may have timely notice of, and provide for any *Casualties* that happen to the *Body*. For tho' all the Changes of the *Fibres*, consist only in some certain *motions*, which commonly do only gradually differ; yet must the *Soul* consider them as Changes that are Essentially distinct, and that forasmuch as they cause so great an Alteration in the *Body* to which it is joyned. For the *Motion*, by Example, that causeth *Pain*, tho' it frequently differ but little from that *Motion*, the effect whereof is *Titillation*: Yet, because by the former some of the *Fibres* of the *Body* may be pluck'd out of their places, or broken, whereas the latter is an Argument of the firm and entire Constitution of our *Body*, so it is that the *Soul* apprehends these 2 *motions*, as being essentially distinguish'd. As to what particular *part* of the *Brain* the *Soul* hath chosen for its Residence, shall be declared in the next *Part* of these *Institutions*.

But you'l say, It cannot be denied, but that we see with our *Eyes*, and feel pain in our *Feet*: Why then should we say, that the Function of *Sense* is only performed in the *Brain*, and not rather in these outward *Organs* of our *Bodies*?

XI. *The Impression from the Objects is only made upon the Soul.*

True it is, that the *Impression* that is made by the *Object*, is begun in the *Organs* of the outward *Senses*; but it is not perfected or compleated there. We see with our *Eyes*, forasmuch as the Impressions of *Light* and *Colour* are made upon them: But all this while the *Action* of the *Soul*, whereby this *Impression* is perceived, is exerted in the more particular and chief *Residence* of the *Soul*; as will appear more plainly in what follows.

CHAP. XII.

Of the Senses in particular; and first of the Touch.

I. *The Touch is first to be treated of, as being the most common and necessary of all the other Senses.*

THo' the *Touch* be but a Dull *Sense*, and with respect to its *Action* be Inferiour to the other *Senses*, yet we must first of all handle it; not only because it is the most *necessary Sense*, but also the most *common*, as being to be found in every *Animal*, how imperfect soever, and diffused throughout all the Parts of our *Body*. That it is more *Common* than the rest of the *Senses*, appears in this, that the other *Senses* are nothing else, but several *Species* of *Touching*; which tho' they be perfect and exquisit, yet cannot their *Functions* be understood, but with some proportion to the *Function* of the *Touch*. For no *Organ* of our *Body* can be moved, without another *Body* touching it. Besides, the *Touch*, like the other *Senses*, is not tyed to one particular part of the *Body*, but is found in all the *Nervous*, *Fibrous*, and *Membranous* parts of it. For it is communicated to the whole *Body*, as a Cap-a-pee Armour, to receive the Attacks and Impressions of all *Sensible Qualities* It is also very *necessary* for the defence of *Life*, and the avoiding of *Dangers*, which our *Bodies* are obnoxious to from *External Objects*. For the *Touch* is as it were our *Monitor*, advising us what we are to *avoid*; and what we are to *do* in these, or the other Circumstances.

II. *What the Touch is.*

The *Touch* therefore, as it is distinguish'd from the rest of the *Senses*, may be defined, *An outward Sense that is most common and necessary, by means whereof an Animal doth receive Tangible Qualities.*

III. *The Touch divided into an Inward and Outward.*

And thus the *Touch*, as it is taken in a larger Sense, may be distinguish'd into *Internal* and *External*: That being the *Inward Sense* of *Touching*, which is performed in the *Inward Organ*; for seeing that the *Nerves* and *Fibres*, which are the the *Organs* of these *Senses*, are dispersed within, as well as on the outside of the *Body*, accordingly there is an inward as well as an outward *Sense* of *feeling*. And therefore the *Veins*, *Arteries*, *Membrans*, and their appendages the *Coats* are partakers of this *Sense*. Thus the *Pain* which we feel in our *Guts*, and in other *fibrous* parts, belongs to this *Inward Touch*. For this *Sense* is excited upon every least *motion* that is made in any *fibrous* part, supposing it to be strong enough to be conveyed to the *Brain*.

The

G. Freeman Invent: M. Vander Gucht. sculp:

To the Right Worshipfull Sr.
John Wentworth of North Elmes-
hall in the West Riding of
Yorkshire Baronet
This Plate is humbly Dedicated by Richard Blome

IV. *The Organ of the Touch, or Senſe of Feeling aſſigned.* The *Organ* of *Feeling* is neither the *Fleſh*, nor the *Membrans*, nor the *Skin*; but the *Nerves* and their *Filaments*, diſperſt throughout the whole *Body*. For this *Senſe* is excited, as oft as the *Nerves* and their *Filaments*, being ſhaken with more force than ordinary, do communicate their agitation to thoſe parts of the *Brain* they more particularly relate to; as we ſee it happens in a ſtretched Cord, which being ſhaken at one end, immediately imparts its *motion* to the other.

V. *The Opinion of our Modern Anatomiſts concerning the Organ of Feeling.* Our *Modern Anatomiſts* fix the Organ of *Feeling* either in the *Skin*, the whole *Subſtance* whereof is *Nervous*, or in ſome *Bodies* that lye between the *Skin* and the *Cuticle*, which with MALPIGHIUS they call *the Sinewy*, or *Nervous Nipples of the Skin*, which they take to be the primary and immediate *Organ* of the *Touch*; becauſe theſe little *Nipples* or *Prominences* are found to be more in number, and larger in thoſe parts of the *Body* that are endued with the moſt exquiſite *Touch*, as the *Palm* of the *Hands*, and the *Ends* of the *Fingers*, than in the other parts. MALPIGHIUS firſt diſcover'd theſe in the *Feet* of a *Lamb*, *Hog*, and other *Animals*; for as ſoon as their *Hoofs* are pull'd off, certain little *Bodies* do appear extended in length, and reaching to the *Surface*: So that *Hoofs* and *Nails* ſeem to be nothing elſe, than the appendages of the *Cuticle*, and of the *Nervous Nipples*, which being pull'd out do leave certain hollow *Pipes* behind them.

VI. *In what parts of the Body theſe Nervous Nipples may be diſcerned.* Theſe *Nipples* are not only diſcover'd by the help of a *Microſcrope*, but alſo by the bare *Eye*, in the extream parts of the *Noſtrils* of ſome *Animals*; as of an *Ox*, *Swine*, *&c.* And that the *Organ* of *Feeling* is chiefly to be plac'd in theſe *Nipples*, MALPIGHIUS with reaſon conjectures, becauſe they are nothing elſe but a propagation of the *Nerves* and *Tendons*, proceeding from the *Fibres* of the *Muſcles*. And foraſmuch as the *Touch* is performed, as well as all the other *Senſes*, by the *Nerves* and *Fibres* of the *Tendons*, it ſeems that no more proper *Organ* of the *Touch* can be aſſigned: Foraſmuch as according to STENO's Obſervation, the *Skin* is for the moſt part nothing elſe, but a *Texture* of *Nerves*, *Arteries*, and *Veins*.

VII. *What are the Objects of the Touch* The *Cauſes* or *Objects* of the foreſaid Affections, which the *Schoolmen* call *Senſible Qualities*, are *Heat* and *Cold*, *Moiſture* and *Drineſs*, *Hardneſs* and *Softneſs*, *Heavineſs* and *Lightneſs*, *Smoothneſs* and *Roughneſs*, *Titillation* and *Pleaſure*; and other *Modifications* of the *Body*, which produce ſome change of *Motion*, *Texture* and *Figure* in them. For all *Objects* indifferently cannot affect the *Touch*, but it is requiſite that the Affection be conſiderable, and ſuch as to make it ſelf ſenſible. For ſeeing that the *Nerves*, which are the *Organs* of this *Senſe*, are of ſome Bigneſs, they cannot be moved by very little *Bodies*; becauſe, according to an *Axiom* in *Natural Philoſophy*, *a Body greater in Extenſion being at Reſt, hath by ſo much the greater force to reſiſt a leſs.* Which is the Reaſon that we do not *feel* the continual *Steam* and Emanation of little *Bodies*; for tho' they paſs through our *Skin*, yet becauſe their Littleneſs is ſuch that they cannot ſufficiently ſhake the *Nerves*, neither are they able to make any impreſſion upon the *Organ* of *Feeling*. And the ſame alſo is to be ſaid with reſpect to the other *Senſes*.

VIII. *How the Senſe of Feeling is performed.* But to the end we may more clearly underſtand how this *Senſe* comes to be exerted, we muſt call to mind, what hath been ſaid in the *foregoing Chapter*, *viz.* that ſome Strings or *Filaments* proceeding from the *Brain*, are diſperſed throughout all the parts of our *Body*, and that theſe conſtitute the *Nerves*, which being filled with the *Animal Spirits*, are ſtretched out like ſo many *Cords*, which are diffuſed throughout the whole *Body*. Which *Nerves* whenever they are ſomewhat forceably ſhaken, immediately draw the parts of the *Brain*; as when a *Rope* is pull'd, the *Bell* which is at the end of it *ſounds* immediately; and by this means the *Soul*, which reſides in the *Brain* receives a *ſenſe* of the *thing* which hath moved the *Nerves*. Thus when we put our *Hand* to the *Fire*, the *particles* thereof being ſwiftly moved, are of ſufficient force to agitate the *Skin* that covers the *Hand*, and conſequently the *Nerves* that reach from the *Hand* to the *Brain*, and thereby to make the *Soul* to perceive the *ſenſe* of *Pain*. For ſuch is the near Relation between the *Brain* and all the *Nerves* diffus'd through the *Body*, that the *Soul* by their means receives the Impreſſion of *External Bodies*. Thus we can diſtinguiſh ſeveral *Bodies*, by means of a Stick held in our *Hands*, and reaching to the *Bodies* we would diſtinguiſh, as *Stones*, *Clay*, *Metals* and the like. Yea there are ſome perſons *born blind*, who only by their *Touch* can diſtinguiſh the ſeveral ſorts of poliſht *Marble*, and the various impreſſions of *Coin*. And for the ſame reaſon it is why any motion on the *Lips* is ſo very ſenſible, *viz.* the great tenderneſs of the *Skin* that covers them, which makes the *Fibres* of thoſe *Nerves* that conſtitute it to be eaſily ſhaken and moved, as before hath been ſaid of a ſtretched *Cord*.

IX. *An Objection Anſwered.* It may be you will object that the *Nerves* are not ſo ſtretched, as a *Rope* or *Cord* is. I grant it, yet doth not this hinder the inſtance of a *Cord* to be very proper here, ſince it is not needful that in a ſimilitude all things ſhould be the ſame. Now a *Cord* and a *Nerve* agree exactly in this, that as when one end of a *Cord* is touch'd, the other is ſhaken; ſo when any *Nerve* in the *Body* is moved, the *motion* is immediately conveighed to the *Brain*. For tho' the *Nerves* be not ſo much ſtretched as a *Cord*, yet their apt diſpoſition for the communication of *motion*, fully makes amends for that want of *Tenſion* in them.

X. *Whence the Difference of the Touch proceeds, ſeeing that the Nerves are the ſame.* But if it be ſo that the *Senſe* of *Feeling* is performed by the *Nerves* derived from the *Brain*, it may be queried whence ſo many *ſpecies of Feeling* do ariſe: For tho' there be many *Nerves* in the *Body* of *Man*, and manifold *Tangible Qualities*, yet there are no different *Nerves* made uſe of, for the producing of theſe different *Affections*: for the very ſame *Nerves* that produce *Pain*, cauſe the ſenſe of *Pleaſure* alſo, and ſo of the reſt; but the ſame *Nerves* receive the impulſe of the ſeveral *Objects*, being ſometimes moved by theſe, and at other times by others.

XI. *This difference proceed from the Diverſity of the Objects.* I Anſwer, That this Diverſity proceeds from the difference of the *Objects* that affect and move the *Nerves*, much like the ſtrings of a *Lute* which give a different *ſound*, according to the different touches of him that *plays* upon it. Thus when the inſenſible parts of any *Body*, variouſly agitated, are more ſwiftly moved than the *Particles* of our

our *Body*, our *Soul* perceives *Heat*, but if more ſlowly, then we are made ſenſible of *Cold*. Hence it is that what to an *Æthiopian* ſeems *cold*, to a *Scythian* appears *hot*. The ſame thing is likewiſe experienced by thoſe that enter in *Bathes* diſtinguiſht by ſeveral degrees of *Heat*: for having continued ſome time in a luke-warm *Bath*, to prepare themſelves to endure a very hot *Bath*, when they go back out of the *hot Bath* to the luke-warm *Bath*, that which before ſeemed *hot* to them at their firſt entrance, feels now *cold* to them.

XII. *What is the Cauſe of Pain and Pleaſure.*

When the ſmall *filaments* of the *Nerves* are puſht againſt, or drawn with ſo great violence, that they are broken and rent from the Member to which they were faſtned, the *Soul* is made ſenſible of *Pain*; but when the ſaid *filaments* are not broken, but moved without receiving any *hurt*, the *Soul* perceives a kind of *Bodily Pleaſure*, which is called *Titillation*; which tho' with reſpect to its cauſe, it ſeems to differ but little from *Pain*, yet doth it produce a quite contrary effect. So when the *particles* that terminate a *Body*, do with an even *ſurface* preſs the *Skin*, the *Soul* apprehends it to be *ſmooth* and *poliſht*; but if the *ſurface* of the *thing* be uneven, then it perceives it to be *rough* and *rugged*. In like manner when *Bodies* are ſtrongly born downwards, they repreſent to the *Soul* the *ſenſe* of *Heavineſs*; but when they do but gently tend downwards, they afford the *Soul* the perception of *Lightneß*. When the *Particles* of a *Body* are ſo diſpoſed as to reſiſt the *motion* of our *Hand* or other *Members* of our *Body*, the *Soul* perceives the quality of *Hardneß*; whereas when the *Particles* of any *Body* are ſo moved, as not to ſtop or reſiſt the *Bodies* that meet them; the *ſenſe* of *Fluidity* is imparted to it. And the ſame is to be ſaid of all the other *qualities* that belong to the *touch* or *ſenſe* of *Feeling*, which the *Soul* perceives differently according to the variety of the modes whereby the *Nervous Fibres* are affected.

XIII. *How it comes to paſs that ſince the Touch hath ſo many Objects, it is not manifold.*

Another Difficulty may be ſtarted here, *viz.* how the *ſenſe* of *Feeling* can be ſaid to be one only *ſenſe*, ſeeing it hath ſo many *Tangible Qualities* for its *Object*. For if the *Senſes* be diſtinguiſht from each other by their *Objects*, why may not the *Senſe* of *Feeling* be ſaid to be manifold, becauſe it hath ſo many different qualities for its *Objects*?

XIV. *Anſwer to the Queſtion.*

Notwithſtanding all this, we muſt conclude the *Touch* or *Senſe* of *Feeling* to be but *one*: for tho' the *Tangible Qualities* do differ, according to the various *Modifications* of *Bodies*, yet they agree all in this general Notion, that by means of the *Nerves* they move the *ſenſe* of *Feeling*. As the ſenſe of *Seeing* is not ſaid to be double or twofold, becauſe it hath for its *objects Light* and *Colours*, which are expreſt by 2 different *names*; nor the *ſenſe* of *Taſting*, tho' the *Tongue*, which is the *Organ* of it be affected with various *Taſts* or *Reliſhes*. Beſides, the *Senſes* are not only diſtinguiſht by their *Objects*, but alſo by the *Organs* and *Modes* whereby they are affected. And foraſmuch as all *Tangible Qualities* agree in this, that they impreſs the ſame Affection upon the *Organ*, and that the whole difference of them depends on the Diverſity of this Impreſſion, it is evident that the *Touch* muſt be lookt upon as being only one *Senſe*, and not many.

XV. *Some Deceptions of the Touch, inſtanced.*

The ſenſe of *Feeling* is ſometimes deceived, as when *Women* that are ſubject to the *Fits of the Mother*, complain of an extream *cold* in their *Heads*. And thus alſo places under ground, appear to us very *cold* in the *Summer time*, and in the *Winter warm*; when as indeed upon making a tryal with a *Weather-glaß*, we ſhall find that there is no ſuch change in the Temperature of the *Place*.

CHAP. XIII.

Of the Senſe of Taſting.

I. *What the Taſt is.*

THE *Taſt is an External Senſe, whereby an Animal, with the help of his Tongue and Palat, which are furniſht with the Nerves ſubſervient to this Senſe, perceives the ſeveral differences of Taſts and Savours.* Or according to others, the *Taſt* is a ſenſation, by means whereof, after that the *Savoury Object* hath made a due impreſſion of it ſelf upon the prominent and porous little *Nipples* of the *Tongue*, the *Soul* reſiding in the *Brain*, perceives and judges of the difference of the *Savour* or *Relliſh*. For according to the ſentiment of our Modern *Anatomiſts* the *Organs* of *Taſt* are the foreſaid prominent and porous *Nipples* of the *Tongue*, or ſmall *Strings* which proceed from its inmoſt *membran*.

II. *Wherein the Touch and Taſte do agree and differ.*

The Taſt, hath ſome affinity with the *Touch*; and if we will believe ARISTOTLE, it is but a ſpecies of it. For whereas in the other *Senſes*, the *Organs* are affected by their *Objects* at a diſtance, and are agitated by little *Bodies* flowing from them, the *Organ* of the *Taſt*, requires an intimate contact with its *Object*, and cannot be moved by it at a diſtance. Yet there is this difference betwixt theſe *Senſes*, that the *Organ* of the *Taſt* is more intimately penetrated by the ſavoury *Object*, which more deeply inſinuates its ſelf into the *Fibres* thereof, than *Tangible Objects* enter the *Skin*. Hence it is that we ſee that perſons who are *over-tired*, or that are fallen into a *ſwoon*, do preſently revive, upon the drinking of a Draught of *Wine*; and *Men* that are like to *die*, are ſtrangely recovered by taking ſome of the *Cordial* that is called the *Imperial Water*: which ſtrange effects are only to be attributed to this, becauſe the *Particles* of *Wine* and the *Imperial Water* dive deep into the *Pores* of the *Tongue*, and mingling with the *Spirits* do greatly revive them.

III. *Two other ways whereby theſe Senſes do differ.*

Moreover theſe *Senſes* differ alſo, *Firſt* by reaſon of their ſeveral *Organs*: For the *Organ* of *Taſte*, is not like that of the *Touch*, diffuſed thoughout all the *Fibrous parts* of the *Body*, but throughout one part only, *viz.* the *Tongue*; which alone is affected by *Savoury Objects*. *Secondly*, According to the *Diſpoſition* that may be found in the ſaid *Organ*: Thus a *Tongue* that is *dry* and without *Moiſture*, toucheth *dry things*, but perceives no manner of *Taſt* in them. *Thirdly*, Thick and whole *Bodies* affect the *Organ* of *Feeling*; whereas that of the *Taſt* cannot be impreſt upon but by thin and *liquid Bodies*, or ſuch as are divided into ſmall *parts*: and for this Reaſon *Pills* that are ſwallowed whole communicate no *Taſt* to the *Tongue* or *Palate*, or very little, and that only becauſe ſome of the *particles*, in gliding over the *Tongue*, are diſſolved.

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Lens. Inv. I. Kip Sculp.

IV. *The Tongue is the Organ of Tasting.*

The *Organ* of the *Taſt* is the *Tongue*, as well as the *Inward* and *Spungy part of the Palate*, becauſe the *ſurface* of them both is full of thoſe innumerable *Nipples* before mentioned. As concerning the *Tongue* it is evident, that being of a ſoft, looſe and ſpungy *ſubſtance*, it is moſt proper to receive *Savoury Bodies*, mixed with ſome *moiſture*. And accordingly we experience that if we *touch* any *Savoury Matter* with the *tip* of our *Tongue* only, we perceive the *Taſt* of it: for the *Nerves* of the fifth and ſeventh *Conjugation* terminate in the *Tongue*, which being inſerted into 9 or 10 *Muſcles*, become the *Inſtruments* of various *Motions*. For beſides the *Functions* of *Speaking* and *Singing*, this *Organ* of the *Tongue* is of great uſe towards the *moiſtning*, *mixing* and *ſwallowing* of the *Meat*. All theſe *Muſcles* divide the *Tongue* longwiſe into 2 parts, by means of a certain *Tendinous String*, ſo as that this *Organ*, as well as thoſe of the other *ſenſes*, ſeems to be *Double*. Now that not only the *Tongue*, but alſo the *upper part of the Throat* or *Palate* is the *Inſtrument* of *Taſting*, is very manifeſt, for when any *ſavoury meat* paſſeth towards the *Gullet* in order to its being *ſwallowed*, we perceive the *Taſt* thereof, tho' it never touched our *Tongue* in the inward part of our *Palate* (which ſome call the *ſwallow*) forasmuch as its *Fleſh is Spungy*, and very proper to admit the *Particles* of *Savoury Bodies*.

V. *That the Particles of any Savoury Body may enter the Tongue, Moiſture is required to dilute or mingle with the ſaid matter*

Now to the end that theſe *Particles* may penetrate the *Pores* of the *Tongue*, and paſs through the *Texture* of the *Fibres*, ſome *moiſture* is required for to ſteep, reſolve, melt and conveigh them. Hence *Nature* hath ſo provided, that the *Mouth* where the *Food* is chewed, hath a continual moiſture attending it, by means whereof, as a *Menſtruum*, the *Particles* of *Sapid Bodies* are melted, and conveighed into the *Organ*. For as we find that an *Herb* being bruiſed with a *Peſtle*, or any other *Inſtrument* in a *Wooden Diſh* or *Bowl*, doth with its *Liquor* penetrate the *Wood*, and inſinuate it ſelf into its *Pores*; as is evident from the *Smell* and *Savour* of the *Herb* that remains in the *Bowl*: in like manner our *Food* being minced in our *Mouths*, by the help of our *Teeth* into ſmall pieces, and ſteept in our *Spittle*, doth eaſily affect the little *Nerves* of our *Tongue*, and is conveighed to the inmoſt parts thereof. And therefore *Salt* before it can affect the *Tongue* and be taſted, muſt be *melted* with ſome *moiſture*; neither can *Pepper* be *taſted* except it be firſt ſteeped in, or mingled with the *Sputtle* that is in the *Mouth*: for dry *Bodies*, without the *Vehicle* of *moiſture*, cannot be conveighed to the inmoſt Receſſes of this *Organ*.

VI. *How the Senſe of Taſting is performed in the Tongue.*

From what hath been ſaid, it may eaſily be underſtood, how the *ſenſe of Taſting* is performed, *viz.* when any *ſavoury matter*, being, as it were macerated with the *Spittle*, is conveighed into the *ſpungy ſubſtance* of the *Tongue*, and in its paſſage doth after divers manners affect the *Nerves* inſerted into the *Tongue*, by vellicating, *biting*, *ſtriking*, *tickling*, *wringing* and *ſtirring* the ſame. Which different Affections are carried from the *Organ* to the *Brain*, where they make a different impreſſion on the *Mind*, according to the diverſity of the motion of the *Fibres* of the *Organ*. So that now it remains only to be explained whence the great variety of *Taſtes* and *Savours* doth proceed.

Which will eaſily be done, if we remember that the *Faculty* of perceiving *Taſtes* in us, is not unlike to that whereby we are ſenſible of *Pain*; that is, to the actuating of this *Power* nothing elſe is required, but that the *ſavoury Bodies* do move the ſlender *filaments* of the *Nerves* of the *Tongue*, or the prominent *Nipples* before mentioned, in ſuch a manner, as Nature hath ordained for the effecting of the *ſenſe of Taſting*. In like manner as to the production of the *ſenſe* of *Pain* it is ſufficient, that the *Nerves* ſubſervient to the *Touch* be moved after ſuch a particular manner: So that all the difference of *ſavoury Bodies* doth depend on the *Thickneſs*, *Figure* and *Motion* of their *Parts*. This may be evidenced by ſome inſtances; for let us ſuppoſe the foreſaid *Fibres* of the *Tongue* to be agitated 4 ſeveral ways, *viz.* by *Salt*, *Vinegar*, or any other ſour Liquor, *Common Water* and *Brandy*, ſo as that the *Soul* thence is ſtirred up to perceive 4 diſtinct *Taſtes*. We ſhall eaſily conceive that *Salt* doth therefore prick, and as it were cut the *Organ*, becauſe it conſiſts of long, ſtiff and various corner'd *Particles*, which with their points prick the ſmall *Fibres* of the *Tongue*, and enter the ſame without the leaſt bending or plying. *Vinegar* applied to the *Organ*, doth as it were ſlaſh and cut it, and by compreſſion ſomewhat contract it, becauſe the *particles* thereof by entring obliquely into the *Nerves*, do ſlaſh the thin *particles* thereof, and daſhing againſt the thicker parts they become bended, and ſo enter the *pores* ſlantingly. *Common Water* doth not enter the *pores* of the *Tongue* at all, and therefore doth neither prick nor pierce it, becauſe its *particles* do only ſoftly flow upon the *Tongue*, and lying ſideways, becauſe of their eaſie *pliableneſs* and bending, are ſcarcely perceptible by the *Taſte*, and therefore *Water* is lookt upon as *inſipid*. *Brandy* doth bite and vellicate the *Tongue*, becauſe the *particles* thereof penetrate moſt deeply, and are moſt ſwiftly moved. And the like account may be given of all other *ſavoury Bodies*, which according to the different diſpoſition of their parts, can make different impreſſions upon the *Organ* of *Taſting*.

VII. *Whence the Diverſity of Savours and Reliſhes doth ariſe.*

VIII. *The Difference of Taſtes may proceed alſo from the Variety of the Organ.*

The difference of *Taſtes* may alſo be cauſed by the *Organ*; for the various *Texture* and Diſpoſition of the *Tongue*, may occaſion a difference in the *Taſte* of things. Thus *perſons* that have a more fine and tender *Organ*, take delight in delicate *Savours* and *Taſts*; whereas thoſe whoſe *Inſtrument* of *Taſting* is more groſs, delight in more courſe *viands* and leſs exquiſit *Taſts*. Thus *Country People* generally delight in courſe and *Salt Meats*; whereas *Children* are pleaſed with *Sugar* and *ſweet things*. The reaſon is, becauſe the *Fibres* of the *Nerves* are more fine and ſubtil in *Children*, and therefore are eaſily moved with a *ſweet Taſte*: whereas thoſe of *Ruſticks* are more groſs and ſtiff, upon which nothing but ſtrong and ſharp *things* can make any impreſſion. Wherefore it is no wonder to ſee that the *Food* which pleaſeth the *Palate* of one *Man*, doth diſguſt another; becauſe of the different diſpoſition of the *Organ* in them both.

Yea it frequently happens that the ſame perſon, who at one time is pleaſed with ſome kind of *Meats*, may at another have an averſion againſt them; and we commonly experience, that thoſe things which are moſt grateful to our *Palates* when we are *Hungry* and *Thirſty*, become un-

pleasant to us when we are full and satiated, and this because of some change in the *Texture* of the *Organ*, the *Savoury particles* not affecting the *Tongue* and *Palat* in the same manner, when the *Pores* of it are more straitned, than when they are dilated and more open.

IX. *Why some loath those Viands which before they desired.* Hence it is that *Old men* do loath some sorts of *Meat*, which they most delighted in when they were *Youths*; and that some Persons, after having accustom'd themselves to some sort of *Food*, are greatly delighted therewith, tho' before they loathed and could not endure it: Even because either the *Organ* in process of time grows dryer; or else, for that by *Custom*, and the frequent use of some sorts of *Diet*, some *folds* are formed in the *Organ*, which easily admit the *particles* of the *Meat*, which before they could not receive. The said variety of *Taste* may also proceed from the *Tongue*, being ting'd with the Savour of some *Salt*, *Bitter*, or *Sowr matter*, which hath not been effac'd by the eating of some *Sweet thing*, or by the *drinking* of a large draught of *Liquor*; for the Eating of *Sweet-meats*, and especially *Drinking*, doth so resolve the hard and longish *particles* of *Salt*, the crooked *particles* of *Bitter things*, and the cutting *particles* of *Sowr things*, as to carry them along with it: And therefore it is that *Drink tastes* more grateful after the eating of *Sowr things*, and more delightfully affects the *Tongue*.

X. *Deceptions of the Taste, and the Causes of them.* Sometimes the *Taste* happens to be mistaken, not about the Affection impreſt upon the *Organ*, but about the Cause from whence it proceeds. Thus they who are *sick* of the *Jaundies*, are not mistaken in that they suppose themselves to perceive a bitter *taste*; for they do so, because the *Gall* is mingled with their *Spittle*; but they are deceived in attributing that *bitter Taste* to the *Food* they eat: In the same manner as they suppose the *Objects* they behold to be *yellow*, when indeed it is the *Gall* that depraves their *Organ*, and makes all the *Objects* they behold to appear of that Colour. And in like manner, sometimes our *Meat* seems to *taste* bitter to us, whereas indeed the said *sense* of *Bitterness* proceeds either from some *Humour*, wherewith the *Tongue* or *Palat* is tinged; or from the *Vitiating of the Nerves*, that are assistant to the *Fibres* of the *Tongue*. Yea, it happens sometimes, that we seem to perceive a *Taste*, without receiving any *food*, which cannot proceed from any other Cause, but from the defluxion of some *Humour* that hath such a kind of *taste*, or from some fault in the *Blood*, that is conveyed to the *Organ* of *Tasting*; as may be demonstrated by many Examples.

CHAP. XIV.

Of the Sense of Smelling.

I. *Why Beasts excel Men in the Sense of Smelling.* IT is certain, that *Man* is Inferiour to many *Beasts*, as to the exquisitness of the *Sense* of *Smelling*: For *Beasts*, when they light upon any unknown *food*, do presently, by the Quickness of their *Scent*, discover the *Qualities* thereof, *Nature* thereby preventing those Mischiefs which otherwise might be the effect of their Voracity, by their too greedily devouring things hurtful to them, if they were not assisted with such an Exquisit *Scent*, which discovers to them the Suitableness or Unsuitableness of the *Food* to their several *Natures*. By this Quickness of their *Sense* of *Smelling* they hunt out their *Prey*, tho' at a considerable distance from them, and tho' never so cunningly hid; according to the Relations we have in Story of *Ravens*, *Vulturs*, and *Apes*. Thus *Dogs*, by the Vivacity of this *Sense* pursue their *Game*, and follow the Steps of their *Masters*, tho' far out of their sight. *Tigers*, by the help of their *quick Scent*, pursue those that have robb'd them of their *Whelps*; and *Cats* find their way home, from whence they have been carried many Miles in a close shut-up *Basket*.

II. *Why the Sense of Smelling is more dull in Man, than other Animals.* Now this *Sense* is more dull in *Man*; not only, as some suppose, because he abuseth this Faculty, and fills himself with the *Vapours* of too great variety of *Meats*: But either, because his *Organ* is not of such an Exact *Texture*; or because his *Brain* is too moist, and so dulls and clogs the force of the *Odorous Steams*, by entangling the *particles* thereof, and hindring them from entring the *Pores* of the *Nostrils*. And for the same reason it is that we can *smell* nothing under *Water*, because the *Nostrils* being stopt with *Water*, cannot admit the *Air* that conveys the *Odorous Exhalations*. Hence it is that they that have their *Heads* stuffed with a *Cold*, in a great measure lose their *Sense* of *Smelling* for that time; because the *Pores* that should admit the *Odorous Exhalations* are filled with the *Rheum*.

III. *What the Sense of Smelling is.* *The Scent*, or *Smelling*, *is an External Sense, whereby an Animal, with the help of his Nostrils, which are furnish'd with very subtil Fibres, receives all manner of Smells.* In all *Smelling* there is *first* a Collection of *Odours*, the Instrument whereof is the double *Cavity* of the *Nostrils*: In the *Next place*, the Sensation of the collected *Odour*, is propagated by means of some most *Subtil Fibres*: And, *Lastly*, this *Sense* is terminated and compleated by the agitation of the *Nerves* and *Spirits*, in the *Conarion* or *Pine Apple-like Kernel*.

IV. *What is the Organ or Instrument of Smelling.* The *Anatomists* differ in their Opinions about the *Organ* of this *Sense*: For some of them make the *Processus Mammillares*, so called, to discharge this *Function*, which others attribute to the *Nostrils*. The *Processus Mammillares*, are 2 little *bunches* or protuberances of the *Brain*, in which 2 *Conduits* or Passages of the same *Substance* are terminated. However, these do not seem to be the *Organ* of *Smelling*; because both these *Mammillary Processus* are a portion of the *Brain* it self, consisting of the *Pith* or *Marrow* of it: Now, no *Physicians* ever owned the *Brain* to be the *Organ* of the *External Senses*. Besides, according to what we have before declared, the *Nerves* and *Fibres* are the *Organs* of the *External Senses*; but these *Processus* are too soft to be accounted *Nerves*; neither did ever any, that I know of, account them so. Moreover, if we place the *Smelling Faculty* in both these *Processus*, why do not we always perceive some *smell* or other, seeing that the *Air* continually flows to the *Brain*, with which the *Odorous Steams* are always mingled; but this contradicts Experience. It remains therefore, that we place the *Organ* of this *Sense* in the *Nostrils*, that is, in some very *subtil Fibres*, derived from the bottom of the *Brain* to the *Nerves*, which are not distinct from the *Nerves* that assist the *Sense* of *Tasting*, save only in this, that they do

Lens Inv. I. Kip Sculp.

To the Right Worship= full S.r Comport Fitch
of Eltham and Mount= Maſcall in Kent Baronet,
Son and heyre of S.r Thomas Fitch of the ſaid
places Knight & Baronet Deceaſed, by Ann his
Lady Daughter & Heyres of Richard Comport
of Eltham aforeſaid Gen= tleman, deceaſed.

This Plate is humbly Dedicated by Richard Blome.

do not pass through the *Skull*, wherewith the *Brain* is cover'd; and that the *Fibres* also are more subtil and fine, than those that are affected by *Savoury Objects*.

V. *The Organ of Smelling is in the Nostrils.*

Sense it self assures us, that the *Organ* of *Smelling* is in the *Nostrils*; for who doth not experience that in them he *Smells*, that is, perceives the Affection that is impress by *Odorous Objects*? To which we may add, that forasmuch as this is a most *subtil Affection*, as being impress by that *most fine Steam* wherein the *Odour* is diffused, it doth not seem possible to be performed in any *Bone*, *Gristle*, or *Thick Membran*, and consequently that it can no where so properly be performed, as in this fine *Texture* of the *Nervous Fibres*.

VI. *Why those that are flat Nos'd do not smell well.*

Whence it is that those who have their *Nostrils* flatted or beaten down by any *bruise* or *fall*, have but a weak or dull *Sense* of *Smelling*; because the *Nerves* design'd for this Function are too much compress in the upper-part of the *Nostrils*, and cannot give a free passage to the *Odorous Exhalations*. And on the contrary, *Dogs*, *Hares*, and other *Animals*, that excel in this *Sense*, have many little *Pipes* in the thin *membran* of their *Nostrils*, through which these *Odorous Exhalations* are freely transmitted.

VII. *How the sense of Smelling is performed.*

The *Sense* of *Smelling* therefore is effected, when the most thin *Particles* of *Bodies* flying in the *Air*, I mean such only as are Subtil and Brisk enough for this purpose, do strike, tickle and vellicate the most thin *fibres* of the *Organ*, and affect it after various manners. The *Hollowness* of the *Nostrils* is a great help and advantage to the perception of *Odours*, especially if the said *Cavity* be wide at the Entrance, because then the *Odoriferous Particles* are more readily conveyed to the *Brain*. For the Cavity of the *Nostrils*, is like a *Chimney* or *Funnel*, through which the *Odorous Particles* do ascend, and being gather'd together, do penetrate the winding of the *Nostrils*. Wherefore they that have long *Nostrils*, have a more quick *Scent* than others; because they attract more of the *Odorous Steams*, whereby the *Sensation* becomes more strong and vigorous.

VIII. *Air is necessary for the conveying of the Odorous Exhalations.*

The *Sense* of *Smelling* cannot be performed without *Air*, wherewith the *Odoriferous particles* being mingled, they are drawn in by the *Nostrils*. For *Air* is the most proper *Medium* for the diffusion of *Odours*; not only because it is of absolute necessity to *Respiration*, but also because the *Odour* is both further and more easily diffused and transmitted thereby. Accordingly we see, that the stench of *Carkasses* is mostly carried towards that part whither the *Air* is driven by the *Wind*. For this is the Nature of this, as well as of all the other *Senses*, that except the *Organ* it self be struck upon, no Sensation is effected; for the *Organ* of *Smelling*, must be struck with the same Force wherewith the *Air* is drawn in. For the *Air* being the Vehicle of the *Odoriferous Exhalation*, a good part of it is let down into the *Wind-pipe*, whilst the other more affecting a streight *motion*, enters the *Nostrils*, and dasheth against the *Organ* of *Smelling*; which *Odoriferous Steam* is so long perceived, as the *Air* is drawn in by the *Nostrils*, and ceaseth to be felt, when it is breath'd out again. The Reason whereof is, because the *Pipes* and *Passages* in the *Nostrils*, which are opened by drawing-in of the *Breath*, and the Entrances whereof are towards the end of the *Nose*, are shut again upon the breathing-out of the *Air*, and consequently it is necessary that thereupon the *Sense* of *Smelling* should be intermitted, and all sensible Impression upon the *Organ* cease. Whence it is easily understood, why one that hath a *stinking Breath* doth not perceive the *smell* of it himself, whilst he breaths it out through his *Nostrils*; because the hollow Passages of the *Nostrils* are shut up, and *Odours* cannot be received contrary to the Course or Grain of the *Fibres*.

IX. *The Odorous Object is to be at some distance from the Organ.*

The *Odoriferous matter* cannot be perceived, except it be at some distance from the *Nostrils*; because when there is a due Distance, the *Terrestrial Particles*, which are always in great abundance mixed with the *Air*, are the more easily dissipated and disperst: As a *Sword* must be *unsheathed* before it can do any Execution; and an *Arrow* must be taken out of the *Quiver*, before it can make a *wound*. For the abundance of *Evaporations* do too much agitate the *Nerves*, subservient to the *Sense* of *Smelling*, and by stopping up their *Pores*, hinder the supervening *Steams* from penetrating them. Hence it is, that an *Odour* that comes from far, is more grateful and pleasant, because those *Heterogeneous* and *Grosser particles*, which are mixed with the *Odoriferous steam*, do by degrees sink downwards, leaving the rest pure and unmixed; which entring the *Nostrils*, produce a purer and more refined *Scent*.

X. *What a Smell or Odour is, and whence diversity of Odours doth proceed.*

Forasmuch therefore as every *Odour* is a *Steam*, which exhaling from the *Odoriferous Body*, and being diffused through the *Air*, doth move the *Organ* of *Smelling* in the *Nostrils*, after a certain determinate manner, and with Force enough, it may be easily understood, what is the chief Cause of the variety of *Odours*. For seeing that these *Steams* consist of almost innumerable *Filaments* (of which we have an Example in the Steam of a *Candle* newly extinguish'd) which may be variously crooked and bent, it cannot be question'd but that according to the variety of their *Particles*, they do more or less move the *Odoratory Nerves*, and thereby give occasion to the *Soul*, of perceiving great diversity of *Odours*: So as that those *steams* produce grateful and sweet *Odours*, whose Motions are very moderate, and duly temper'd together; and those on the contrary produce loathsom *Smells*, which are more vehemently agitated, or else whose Motion is too dull and slow. For those *Bodies* that do not strike the *Organ*, and in some sort press upon it, cannot excite the *Sense* of *Smelling*.

XI. *Deceptions of the sense of Smelling.*

That we may be deceived in the *sense* of *Smelling*, is evident from divers instances. For CARDAN in his *8th Book de Varietate Rerum, Chap.* 43. declares, that he always perceived the *Smell* of something or other in his *Nostrils*, as sometimes the smell of *Flesh*, sometimes that of *Frankincense*, and at other times the smell of some other thing. LEWIS XI. in his *melancholy fits*, conceited that every thing that was about him had an ill *smell*. There was also a French Poet that was a very *melancholy Man*, who being *sick* of a *Fever*, and persuaded by his *Physicians* to have his *Temples anointed* with *Unguentum Populeum* to make him *sleep*, conceived such an aversion for it, that for many *years* after he imagined that every thing

that

that was about him, ſmelt of it. There have been ſome *perſons* likewiſe (as BARTHOLINE informs us, *Hiſt. Nat. Centur.* 4.) that could *ſmell* things that ſmelt well, but not ſuch as did ſtink, or had an ill *ſmell*. The ſame *Author* tells us of an *Apothecary*, who had loſt this *ſenſe*, by the too frequent uſe of *Camphire*. And SCOTTUS *Phyſ. Curioſ. Cap.* 33. gives us an account of a *Woman*, who never could *ſmell* any thing.

CHAP. XV.

Of the Senſe of Hearing.

I. *What the Senſe of Hearing is.*

HAving ſpoken of the Senſes of *Feeling*, *Taſting* and *Smelling*, we next proceed to handle that of *Hearing*. *Now Hearing is an External Senſe, whereby an Animal, with the help of his Ears, and the Nerves implanted in the Cavities thereof, receives Sounds.* Or more plainly, *Hearing is that Senſation, whereby from a due motion of the ſmall Fibres of the Auditory Nerves, impreſt upon the Ears, and conveyed to the Brain, or common Senſe, the Soul perceives Sounds, and judgeth of them.* For *Hearing*, as well as every other *Senſation*, is founded upon the help and mutual concurrence of *Soul* and *Body*. For in this *Senſe* the *Preſence* and Action of the *Soul* is required; becauſe when the *Soul* is otherwiſe employ'd, the Excitation of *Sounds* ſignifies nothing to it, tho' they be never ſo loud and violent; for then tho' the *Ears* be open, yet no *ſenſe* is perceived, becauſe of the inadvertence, and want of Attention in the *Mind*.

II. *The Uſefulneſs of this Senſe.*

This *Senſe* is more Excellent than any of the foregoing, and is equally neceſſary to *Man*, and other *Animals*. For ſeeing that many things at a diſtance might attack *Animals*, to their great hurt and prejudice, except they were timely forewarned of them, Nature hath furniſht them with this *Senſe* of *Hearing*, whereby they are forewarned to avoid things inimical, and to proſecute ſuch are grateful and ſuitable to them. Moreover *Hearing* is of the Higheſt and moſt Neceſſary uſe to *Man* for the *accompliſhing of his Mind*, as ARISTOTLE ſpeaks in his *Treatiſe, De Senſ. & Senſili Cap.* 10. For ſeeing, ſaith he, that in this ſhort term of life that is allowed us here, we have not leiſure enough to ſearch into the nature of all things, this *Senſe* gives us the advantage of being inſtructed, by liſtning to the informations of *Learned Men*, whereby we are taught our *Duties*, and how we are to behave our ſelves, not only in a *Civil Society*, but alſo in our private and *Houſhold* concerns. For by the Company and Converſation of *Learned Men*, we attain the *knowledge* of *Sciences*, and are admoniſhed how we may become both Wiſe and Prudent.

III. *The parts that belong to the Organ of Hearing.*

Before we can throughly underſtand by what means this *Senſe* is produced, it will be neceſſary for us to know the ſtructure of its *Organ*, and the *principal parts* that compoſe it. The outward *Lappet of the Ear*, which is formed by Nature for the collecting of the *ſound*, and receiving its firſt impulſe, conſiſts of the *flap* or *lappet* and the *Griſtle of the Ear*; this part, which hath a pretty large compaſs, is by degrees ſtraitned, till it ends in the *Hollow* of the *Ear*. Next after this outward Cavity follows the *Paſſage*, or *Auditory Cave*, which is crooked and turned into ſeveral windings, to the end that the *ſound*, which is carried with the *Air*, may be encreaſed by inſinuating it ſelf into them. This Winding Hole leads to a moſt thin and dry *Membran*, which is terminated by, or encloſed with a *Bony Circle*, which is commonly called the *Drum of the Ear*, becauſe it obliquely admits the impulſe of the *Air*, being ſtruck with the *ſound*. To this part 3 ſmall *Bones* and a *Muſcle* are joined, *viz.* the *Hammer*, the *Anvil* and *Stirrup*, which all 3 hang together; for the *Hammer* is jointed into the *Anvil*, and the *Anvil* into the *Stapes* or *Stirrup*. The *Cave* wherein the foreſaid little *Bones* are found, is by ſome called *Concha* or the Shell, and by others *Pelvis* or the *Baſon*; which is large enough, and in a manner of a round *figure*, and leads to a vaſt number of little *Cavities*. Which *Cave*, with all its annexed *Cavities* is not empty, but filled with *Air*, which ſome call *Inborn*, but wrongly, foraſmuch as it is frequently changed, as appears from the free and open paſſage the *Air* hath to them.

IV. *By what Inſtruments the Senſe of Hearing is performed.*

Theſe things premiſed, it will not be difficult to underſtand in what part of the *Ear Hearing* is produced. For it is apparent, that it cannot be effected in its outward *Cavity*, becauſe the outward *Ear* is only like a *Funnel*, through which the ſhaken *Air* may the more freely enter into the *Auditory* paſſage; neither is this *Senſe* performed in the *Auditory Cave* or *Hole*, ſeeing that the ſame ſeems only to have been framed by *Nature*, for the conveying of the *ſound*, and for the perpetual out-flowing of the *ſteam*. Neither is it effected by the little *Bones*, for ſeeing that they want *Nerves* which are the *Organs* of all the *Senſes*, neither can they be ſuppoſed to tranſmit the *ſound* to the *Brain*. It remains therefore, that the ſame be performed in the *Auditory Nerves* that are latent in the ſaid little *Cavities*, there being 2 *Nerves* hid within the ſaid *Cavities*, which receive all the ſhakings and agitations of the adjacent *Air*; by means whereof the repreſentation of *ſound* is communicated to the *Soul*. For the *Air* by ſhaking the *Membran* of the *Drum*, doth at the ſame time move the 3 linked *Bones*, to which theſe *Nerves* are joined: which tremulous impulſe being conveyed to the *Brain*, by the help of the foreſaid *Nerves*, do give an occaſion to the *Mind*, of conceiving the *Idea* of *Sound*.

V. *What Sound is, and how it is formed.*

Sound is a tremulous and waving motion of the Air, whereby ſome part of the Air, being whirl'd into certain Circles, is moſt ſwiftly waved this way and that way. Theſe Circles are framed by the Body that *ſtrikes* or ſhakes the *Air*, as a *Bell*, a *String*, or a *Tongue*, much after the ſame manner as we find that *Circles* are formed in the *Water* when *Stones* are caſt into it, which at firſt are ſmall, and afterwards ſwell greater, one part of the beaten *Water*, driving and puſhing on the other. And like as theſe Circles tend more towards that part whither the ſtream of the *River* tends; ſo the *Wind* carries the *Sound* towards that part, whither it drives the *Air*. Yea as oft as the *Wind*, being hindred in its courſe by meeting with ſome *ſolid Body*, is forced to make a *Circle*, by waving backwards and forwards (as the water makes a *Whirlpool*, when ever it is hindred in its ſtrait

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ſtrait progreſs) ſo often is the *ſound* heard, which operation is little different from that which forms an *Eccho*.

VI. *Whence the variety of Sounds doth ariſe.* The Differences of *ſounds* proceed from the Diverſity of *motion*, as well in the *ſounding Body*, as of the *Air* that is agitated thereby. For that the *ſtrings of a Citttern* do give ſo much a *ſharper* and quicker *ſound*, the more that they are ſtretched, and wound up higher; and the *lower* and duller, as they are leſs ſtretched; is only becauſe the motion of *Cords* that are high wound is more ſwift, and conſequently impreſſeth a ſwifter *motion* on the *Air*, than that which is but ſlack. And therefore the *ſound* is ſaid to be ſhrill and *ſharp*, when the ſhakings or beatings of the *Air*, be more frequently reciprocated, and the *Organ* more ſwiftly ſtruck by them: and it is accounted a low or Deep *ſound*, when the *Vibrations* of the *Air* are leſs frequent, and the *Organ* is more leiſurely ſtruck with the impulſes thereof. So that all the Difference there is betwixt a *high* and *Deep ſound* is this, that in a High or Sharp *ſound* the parts of the *Air* beat more frequently and faſt upon the *Organ*, whereas in the *Baſe* or *Deep Sound*, the Concuſſions admit of longer *Intervals*; as is evident in a ſhorter *ſtring* wound up to the ſame Height, and of the ſame Thickneſs, compared with a longer, becauſe the former will yield a more *high* or *ſhrill ſound* than the latter, foraſmuch as it affords more frequent *Vibrations*, and beats the *Air* and *Ear* with quicker repeated *ſtrokes*.

VII. *The Cauſes of the Harſhneſs and Sweetneſs of Sounds.* In like manner we find a *ſound* to be either *haſher* or *ſweeter*, according as the *Beatings* or *Wavings* of it are more or leſs equal. For if the *ſurface* of the *Body*, whence the *Sound* or *Air* is reflected, or driven back, be *rough* and *rugged*, the *ſound* is more *harſh*: For the ruggedneſs of the *ſurface*, cauſeth ſome *particles* of the *Air* to be puſht away ſooner, and others later, as paſſing through an unequal ſpace; wherefore it is neceſſary that ſome of them muſt come to the *Ear* ſooner than others. And for this Cauſe it is that a *Trumpet* that is not very poliſht and ſmooth, doth give forth a more *harſh ſound*. Whereas a *grateful* and *pleaſant ſound* conſiſts in the equality of every *Undulation* of the *Air*, beating againſt the *Ear*, becauſe in this caſe that whole portion of the *Air*, arrives at the *Organ*, at the ſame time, and ſtrikes it with an even *motion*.

VIII. *The Air is the Medium that tranſmits Sounds* The *Air* is acknowledged by all *Philoſophers* to be the *Vehicle* of *Sounds*, which proceeding by a waving *motion* from the *Sonorous Body*, doth impreſs that Affection upon the *Organ*, which is called the *Act* of *Hearing*: For ſince the *Air* is in continual *motion*, it is eaſily determined by the *Body* that is ſtricken, to produce a *ſound* in us. I am not ignorant that ſome famous Modern *Authors* are of opinion, that the whole *Atmoſphere* of the *Air* is not the *medium* for the tranſmitting of *ſounds*, but only the moſt pure part of it; founding their Sentiment upon this Experiment, that every *ſound*, be it great or ſmall, whether it be carried before or againſt the *Wind*, yet doth always, in an equal meaſure of time, paſs through an equal ſpace of *place*, which could not happen ſo if it were conveyed by the *undulating motion* of the entire *Body* of the *Air*.

IX. *The Sound ſooner or later arrives to the Ear, according as the wind is for it or againſt it.* But I cannot altogether aſſent to this aſſertion; for tho' a *ſound* may be heard by 2 *Men*, ſtanding at an equal diſtance from the *Center*, at the ſame time, notwithſtanding that the *Air* blow violently, yet cannot it be inferred from thence, that the *ſound* doth not depend upon the *Undulation* of the *Air*. For tho' it be true, that a *Body* that is ſwiftly moved, cannot be carried by that which is more ſlowly moved; yet is that *Body* to be excepted from this general *maxim*, which upholds and ſupports another. For let us ſuppoſe, that whilſt a *Globe* doth move upon a *Table*, the *Table* alſo with a very ſlow *motion* moves towards it, it cannot be queſtioned but that in this caſe the *Globe* doth participate of the *motion* of the *Table*: In like manner thoſe ſmall *particles* of the *Air*, which convey the *ſound*, muſt more leiſurely tranſmit the ſame to the *Ear*, if the *Wind* be contrary. But that 2 *Men* in an equal diſtance from the *Center*, do both *hear* the *ſound* at the ſame time, this is to be imputed to the *ſound* it ſelf, which being moſt ſwift in its *motion*, the difference of time ſeems to be inſenſible.

X. *A Sound is better heard with the wind than againſt it.* Moreover, they who alledge the foreſaid *Experiment*, do acknowledge, that the *ſound* is heard fuller and plainer by him to whom the *ſound* is conveyed by the *Wind*, than to him to whom it comes againſt it. If this be true, we know that the *Wind* cannot make a greater *ſound*, except it carry the *particles* of *ſound* along with it, which it cannot do without moving them; neither can it move them, but that it muſt accelerate or haſten them, and cauſe it to come more ſwiftly to the *Ear*. Let us conclude therefore, that *Sonorous Bodies* do ſhake the whole circumambient *Air*, or rather determine it, as being already in *motion*, to tend to ſome particular part. And therefore that not only the thin and ſubtil *Air*, is the *vehicle* of the *ſound*, but alſo that which is thick and full of *vapours*. This manifeſtly appears in the *Pneumatick Engin*, for when the *Air* is wholly drawn out of it, the *motion* of a *Watch* can ſcarcely be heard in it. Which Experiment doth evidently demonſtrate, that the groſs *Air* doth conduce much to the conveying of the *ſound*, and promotes its propagation.

XI. *How an Eccho is formed.* Foraſmuch therefore as the *ſound* is diffuſed, as it were along every *line*, from the *Center* of a *Sphere*, towards the *Circumference*, it may ſo happen that the *particles* of *Air*, that are on their way to convey the *ſound* to others, may meet a hard *Body*, and being unable to penetrate or agitate the ſame, are forced to *turn back* and be *reflected*, and to rebound their *motion* to thoſe parts whence they had received it, and thoſe again to others, and ſo on. By which means it comes to paſs that the ſame *ſound* is *heard* again, being ſeveral times repeated, which is called an *Eccho*. For *Sound* as well as *Light*, is ſubject to Reflexion, and when-ever a *ſmooth* and *hollow hard body* is interpos'd, it rebounds; but yet with this difference, that a *ſound*, becauſe of the ſlowneſs of its *motion*, cannot advance far in one *Moment*, but wants a longer ſpace of time for its diffuſion. And therefore the further the perſon that receives the *ſound* is diſtant, from that *Body* that reflects it, the more time the *voice* in rebounding takes up: whereas the *Light* in one moment of time *reflects* from ſeveral *Bodies*, and enlightens many *places* at once. If the *ſound* meet with divers *Bodies*, at different diſtances from each other, that are proper to rebound it, there follow many Reiterations of

the ſame *Voice*, *viz.* when the former *ſound* being vaniſht in the neighbouring *Air*, another is formed by the *Air* that is more remote; which being afterwards beaten back from *Opake* and *Hard Bodies* at a greater diſtance, doth again ſhake the neighbouring *Air*, and that either once only, or more frequently. Yea an *Eccho* ſometimes happens in *Bodies* that are very near, as in the *Tiles* of *Houſes*; as when a *Voice* directed from a high place, and level with the *Tiles* of the *Houſes*, enters the hollow that is under the ſaid *Tiles*, and from thence rebounds towards the Speaker, whence it proceeded.

XII. *The Hearing is ſubject to ſome Deceptions.*

Many miſtakes may happen to the *Senſe* of *Hearing*, as well as to the other *Senſes*, which are not imputed to the inward Affection it ſelf, but to the Cauſe of it. Thus a *Buzzing Sound*, or *Noiſe* in the *Ear*, which is commonly attributed to the *External Object*, hath no other cauſe, but that ſome part of the *Steam*, or the incloſed *Air*, or a ſwelling in the *Muſcles* of the *Ear*, affecting the *Organ* of *Hearing*, ſtirs up ſome undulating *motions*: wherefore it is that *Sick People*, becauſe of ſome corruption of their *Blood*, or by reaſon of ſome *Excrements* that cauſe an obſtruction in the *Ear*, do frequently complain of this noiſe in their *Ears*. Another miſtake or Deception in the *Senſe* of *Hearing* is, when upon cutting off of the *Lappet of the Ear*, the *Sound* is received like to *Water* running down from on High; for when this outward *Shell* or *Hollow* is taken away, the *Sound* enters ſtraight into the *Auditory Cave*, and wants that due determination it ſhould receive from the outward part of the *Ear*: For the *Ear-lappet*, as before ſaid, was framed by Nature, for the collecting or gathering of the *Sound*; wherefore when that is wanting, the *Sound* immediately enters into the *Baſon*, as if it came from ſeveral parts, as it happens in the *noiſe* of *running Water*. Neither are we to forget that miſtake, which we are ſenſible of when we ſtop our *Ear*, for then we perceive a kind of tremulous *Buzzing* or *Noiſe*, as if the *Air* did role about in the *Ear*; the reaſon whereof can be no other but this, that the *Steam* is continually paſſing out of the *Ear*, which being hindred from coming out, it puſheth againſt the *Organ of Hearing*, whence this noiſe doth ariſe, which we ſuppoſe to be inward.

As I was not long ſince with ſome Friends going upon the *Thames*, between the two Churches of *Fulham* and *Putney*, it hapned they were *ringing Fulham-Bells*, the *ſound* whereof was ſo rebounded from the oppoſit Church, that it ſeemed equally to proceed from both places; neither was it eaſie for us to determin whence it came, ſo that we had various diſputes about this Deception, being much affected with the Diverſion it gave us.

CHAP. XVI.

Of the Eye.

I. *What the Eye is.*

FOraſmuch as the *Eye*, is the *Organ* of *Sight*, and that within the Receſs or Hollow thereof, the *Images* of the ſeveral *Objects* are repreſented, we ſhall never be able throughly to underſtand how *Viſion* or *Sight* is effected, without deſcribing the diſpoſition and ſtructure of its parts. *The Eye*, therefore, *is the outward Organ of Sight, through the Tranſparent parts whereof the Rays of Light paſs, till they arrive at the Net-work-coat or Membran, and there variouſly moving the ſmall Capillaments of the Nerves, ſuitable to the variety of Objects whence they proceed, do repreſent or pourtray the Image of the Object.* The Inward *Organ* of this *Senſe* are the *Optick Nerves*, which reach from the *Net-work-like-membran* to the *Brain*, and receiving the motion from the ſaid *Membran*, convey it to the common Seat of the *Senſes*.

II. *Of the Figure of the Eye,*

And to the end we may more exactly apprehend all theſe particulars, ſuppoſe we an *Eye* cut through in the midſt, but yet with that Art, as that all the ſeveral *Humors* contained therein, keep the ſame place they had before, without any part of them being ſpilt; and then it would appear to be of the ſame *Structure*, as it is repreſented in this *Scheme*, wherein D B, C B D, ſet forth its round *Figure*, that marked B C B, being the forepart of it, and B A B, the other part, which is encloſed within the *Bone* of the *Head*. Figure 68.

III. *What the Horny Coat of the Eye is.*

B C B, is a hard and thick *Membran*, which the *Phyſicians* call the *Horny Coat* of the *Eye*, being, as it were the *Veſſel* and *Receptacle* to contain all the other parts of the *Eye*; and this part is tranſparent, and more prominent or convex than the Remainder, to which the *Rainbow*, ſo called, belongs, which almoſt is of different *colours* in all Men. It ſticks out forwards, becauſe if it were more flat, the Beams which ſlantingly touch its *ſurface*, would ſcarcely ever reach the *Bottom* of the *Eye*, through the entrance of the *Apple* thereof; ſo that we ſhould only perceive a very ſmall part of the *Hemiſphere* at one caſt of the *Eye*.

IV. *The Uveous or Grape-like Coat, and the Apple of the Eye.*

D E F, is a thinner *Membran*, ſtretched out like a *Hanging* or *Tapiſtry*, and is called the *Tunica Uvea* or *Grape-like Coat*, for that it is perforated like a *Grape* when the *Stele* is pluckt out of it. In this *Membran* or *Coat* is a ſmall hole, the *Apple of the Eye*, in the midſt of the *Rainbow*, marked out by the Letters F F, called in Latin *Pupilla*, becauſe in it a *Baby* or *little Image* is repreſented by the *Rays* that are reflected from the *ſurface* of the *Eye*, to every one that looks upon the *Eye* of another. The *Apple* of the *Eye*, in a *Man*, appears Black, becauſe that part of the *Coroides*, or the *Grape-like Coat*, which anſwers to it, is of that *colour*. The contexture of *Fibres* rang'd in a circle, and which outwardly is placed about the hole of the *Apple* of the *Eye*, being diverſified with various *colours*, is called the *Rainbow*.

V. *The Ligaments of the Eye-lids.*

N N, are many *black Filaments*, called *Proceſſus Ciliares*, which do every way ſurround, and gird in a certain ſoft and tranſparent *Body*, called the *Cryſtalline Humour*, and keep it ſuſpended in the midſt of them.

VI. *The Watry Humour.*

The ſpace contained betwixt E K E, is filled with another tranſparent *Humour*, which is therefore called the *Watry Humour*, becauſe in all reſpects it is like *Water*. This *Humour* gives the Round *Figure* to the *Eye*, refracts the admitted *Beams*, and in this diſpoſition imparts them to the *Cryſtalline Humour*. The *Eye* continually receives of this *humour* by ſome particular *Veſſels* which are in the *Sclerotica*, which is a part of the *Horny Coat* or *Membran*, and which are inſerted into it, near to the *Apple* of the *Eye*, whence

it

it is that when the *Horny membran* is pierced, and the *Watry Humour* by this means is ſpilt and let out, the ſaid loſs may be repair'd in the time of a few *Hours*.

VII. *The Cryſtallin Humour.* The Mid-part L, is a certain tranſparent *Subſtance*, rather of the *figure* of a *Lentil*, than *Spherical*; for the greateſt part of it is cover'd by the *Rainbow*, and the Fore-part of the greater *Round*, is leſs than the other, and the Hind-part of the leſſer *Round*, is the biggeſt. It is becauſe of its Compactneſs and ſome appearing Hardneſs, called the *Icy Humour*, but more commonly the *Cryſtallin*. This *Humour* is white, like *Starch*, and is of the conſiſtence of *Wax*, which melts, and may be compreſt, but cannot be ſpilt.

VIII. *The Glaſſy Humour.* The remaining Hollow of the *Eye* G M I, is taken up by a *whitiſh Humour*, more tranſparent than the *Cryſtallin* or *Watry*, and of a mean conſiſtence betwixt them both; becauſe it can more eaſily be contracted and diſplayed; and yet it is not ſo liquid, or thin and flowing, as the *Watry Humour*. It is commonly called the *Albumineous* and *Glaſſy Humour*, becauſe it hath the conſiſtence and colour of the White of an *Egg*, and is tranſparent like *Glaſs*. This *Humour* reſts upon the *Network-like Membran*, and contains in it ſelf the *Cryſtallin*; it is encloſed in a very thin *Membran*, which keeps it from ſpilling.

IX. *The Cryſtallin Humour cauſeth much the ſame Refraction of the Rays, as Glaſs doth.* Experience informs us, that the *Cryſtallin Humour* cauſeth much the ſame *Refraction*, as *Glaſs* and *Cryſtal* doth; and that the two other *Humours* produce ſomewhat a leſs *Refraction*, and much about the ſame as *Common Water*: So that the *Rays of Light* paſs more eaſily through the *Cryſtallin Humour*, than through the two other *Humours*; and yet more eaſily through theſe, than through the *Air*.

X. *The Optick Nerve.* H Z, is the *Optick Nerve*, which takes its riſe from the Hinder-part of the *Brain*, not far from the beginning of the *Back-bone*, the *Capillaments* whereof G H I, being diſperſt throughout the whole Space A B H, do cover the whole bottom of the *Eye*, conſtituting a ſort of a moſt fine *Net*, which from its Expanſion is called *Retiformis*, or *Net-work like*, and *Retina* by *Phyſicians*. Now theſe *Capillaments*, by means of the *Convex figure* of the *Eye*, and of the *Cryſtallin Humour*, do collect the *Beams*, and communicate the *motion* they have received to the *Brain*, and preſent it to the *Soul* that reſides there.

XI. *Why the Surface of the Coats of the Eye is black.* My deſign is not to reckon up here all the *Coats* that encloſe the *Eye*, ſeeing that the knowledge of them doth not conduce to the underſtanding of the *Senſe* of *Seeing*; and therefore ſhall only take notice, that the *ſurface* of theſe *Coats* is wholly obſcure and black in thoſe Parts that face the bottom of the *Eye*; and this, to the end that the *Rays* which fall upon the *Net-like Coat* G H I, and from thence are are reflected to the *Grape-like Coat*, might be extinguiſh'd by that *Blackneſs*, leſt being again reflected to the *Retina*, or *Net-like Coat*, they ſhould diſturb and confound the *Sight*.

XII. *The ſix Muſcles of the Eye.* O O, are ſix *Muſcles*, outwardly faſtned to the *Eye*, by the help whereof it can readily move it ſelf every way. Of theſe *Muſcles* 4 are called *Direct*, whereof the *firſt* lifts the *Eye* upwards, the *ſecond* turns it downwards, the *third* draws it towards the *Noſe*, and the *fourth* withdraws it to the oppoſite part from the *Noſe*. The other 2 are called *Oblique* or Slanting, becauſe they encompaſs and ſurround the *Eye*; for with the one of them the *Eye* is enabled to give a ſlanting or oblique Caſt, and with the other it is rolled round.

XIII. *How the Right or Direct Muſcles ſerve to move the Eye.* When the Right *Muſcle*, which is above the *Eye*, is fill'd with *Animal Spirits*, the *Eye* looks up; and the 3 other *Muſcles* being fill'd in like manner by turns, aſſiſt it ſometimes to look downwards, and ſometimes to turn it to the Right or Left. Beſides, it is evident by the ſituation of theſe *Muſcles*, that when all of them are ſhortned, they at the ſame time alter the *figure* of the *Eye*, by making it more flat than it was before.

XIV. *Why the Apple of the Eye is of a Convex figure.* That part of the *Eye*, which is marked B C B, is of a *Convex figure*, to the end that the *Rays* proceeding from the *Objects*, which of themſelves have not force enough to enter the *Apple* of the *Eye* F F, might be united by a various *Refraction*, and by this means might have force enough ſtrongly to move the *Hairy-ſtrings* of the *Optick Nerve* H Z. For the Refraction which is made in the *Cryſtallin Humour* L, procures ſtrength and diſtinction to the *Sight*.

XV. *The Apple of the Eye can be contracted and dilated.* Beſides, this is to be obſerved, that the *Apple of the Eye* is liable to Contraction and Dilatation, according as the *Objects*, to which the *Eye* is directed, are nearer or farther off; or more or leſs enlightned; or according as the *Beholder* doth more intently or careleſly view the *Object*. For this *Coat* hath the power to dilate or narrow it ſelf like a *Muſcle*, and by this means to enlarge or contract the *Apple of the Eye*, *viz.* by ſtinting the entring of the *Rays*, and by cauſing more or leſs to paſs through it.

XVI. *The Motion of the Apple of the Eye is voluntary.* Wherefore this *motion* may be called *Voluntary*, tho' for the moſt part it happen without our Attention; for it doth nevertheleſs depend on our *Will*, or on thoſe *motions* which do accompany the *Will* or deſire of throughly beholding any *Objects*. In like manner as the motion of the *Lips* and *Tongue*, conducing to the formation of *Voices*, is called *Voluntary*; becauſe it is conſequent to our intention of *Speaking*, tho' we do not mind, yea, and are ignorant alſo, what kind of *motion* every Letter requires.

CHAP. XVII.

Of Colours.

I. *Colour is nothing elſe, but a Modification of Light.* FOraſmuch as *Colours* are the *Objects* of *Seeing*, we are to conſider what they are, and wherein their Nature doth conſiſt, before we undertake the Explication of the *Senſe* of *Seeing*. We ſuppoſe therefore in the *Firſt* pleae, that no *Colour* can appear without *Light*, and that conſequently *Colours* are nothing elſe but certain *Alterations* or *Modifications* that happen to the *Light*. *Secondly*, that even *Tranſparent Bodies* alſo, appear diſtinguiſh'd with various *Colours*, if the *Light* that falls upon them be variouſly reflected to the *Eye* of the *Beholder*. As may be ſeen in a *Round Ball* of *Glaſs* fill'd with *Water*, in the *Bubbles* that *Children* ſport themſelves with, in a *Priſm*, in the *Rain-bow*, and in other Bodies.

We

II. *What Light and the Beams thereof are.*

We muſt alſo ſuppoſe the *Light* to be the *Action* of a *Subtil matter*, the Parts whereof, as ſo many ſmall *Pellets*, do roll continually through the *Pores* of *Earthly Bodies*: So that there are innumerous *Rays* or *ſtrait Lines* by which this Action is communicated, which proceed from the ſeveral Points of a *Lucid Body*, and reach to the ſeveral Parts of the *Body* which they enlighten.

III. *That innumerable Rays proceed from every Point.*

For we are to conceive, that there is no *ſurface*, how poliſh'd and ſmooth ſoever it may appear to the *Eye*, but is really rough and unequal; ſo that every Point aſſignable in the outſide of the moſt ſmooth *Body*, is to be imagined like a little *Hillock* or *Prominence*, from whence innumerable *Beams* may be diſperſed round about. For otherwiſe, if the *ſurface* of any *Body* were altogether poliſh'd and ſmooth, it could not ſhed the *Rays* roud about, but only directly to the oppoſite ſide; ſo that the *Object* would only reflect ſuch direct and *Parallel Rays*, as could only reach to the *Eye* obliquely or ſlantingly placed.

IV. *The Rays of Light may be reflected after divers manners.*

Moreover we are to take notice, that tho' the *Rays* paſs ſtrait along through *Traſparent Bodies*, yet they are eaſily turned aſide by others they meet with; much after the ſame manner as a *Ball* ſtruck againſt a *Wall*, rebounds variouſly, according to the difference of the *Surfaces* it lights againſt. For it rebounds otherwiſe from a *plain* and even *Surface*, than from a *crooked*; and otherwiſe from a *hard*, than from a *ſoft*: For being ſtruck againſt a *ſoft Body*, it loſeth its *motion*; whereas lighting upon a *hard*, it rebounds immediately.

V. *The Rays, beſides their motion in right Lines, may alſo be moved round.*

Laſtly, We are to take notice, that as a *Ball*, beſides its *motion* whereby it tends from the *Hand* to the *Wall* in a right *Line*, and from thence rebounds elſewhere, is capable alſo of being moved round its own *Center*: So likewiſe the *Rays of Light* cannot only move to Right *Lines*, but may be ſo reverberated by the *Bodies* they light upon, as to take upon them a *Circular motion*, wholly in the ſame manner as a *Ball* ſtruck by a *Racket*, rebounds againſt the floor or ground.

VI. *What Colours are.*

From what hath been ſaid, it follows, that *Colours* are not in the *Colour'd Bodies*, but are only ſuch a diſpoſition, which either ſwallows up the *Rays of Light*, or variouſly reflects them to the *Eye*, and according to the diverſity of this *motion*, doth differently affect the moſt ſubtil *Organs* of the *Sight*, and by this means produce a Senſe of *Colours* in us. So that *Colours*, as they are aſſignable to *Bodies*, *are* nothing elſe, but *different Modes, according to which Bodies receive the Beams of Light, and either drown them, or with great variety reflect them to the Eye.*

VII. *Wherein the Nature of Colours doth conſiſt.*

Let us ſuppoſe therefore, that there are ſome *Bodies*, which when they are ſtruck with the *Beams of Light*, do choak them, and break all their force; and ſuch are thoſe that are of a *Black Colour*, which is common to them, and Darkneſs. That there are alſo other *Bodies* that reflect the *Beams*, ſome of them in the ſame manner as they receive them, *viz.* ſuch *Bodies*, whoſe *Surface* being exactly poliſh'd, ſerve for *Looking-Glaſſes*. Others, which reflect them confuſedly this way and that way; and again, that amongſt theſe ſome reflect theſe *Rays* ſo, as that the Action of *Reflection* is not ſpoiled by any the leaſt alteration, *viz.* thoſe *Bodies* that are of a *white Colour*. And that others again produce a Change like to that which happens to the *motion* of a *Ball* that is ſtruck with a ſlanting Stroak of a *Racket*; and ſuch are the *Bodies* that are of a *Red*, *Yellow*, *Blue*, or other *Colour*.

VIII. *Colour is nothing elſe, but a Modification of the Rays of Light.*

For when the *Rays of Light* are ſent forth from a *Lucid Body*, the *Globuli* of the *ſecond Element*, which conſtitute thoſe *Rays*, are either evenly or unevenly driven forwards, and whirl'd about by a different Proportion; becauſe of the various *Nature* and Conſtitution of the *Bodies* they meet with. And from this proportion of their direct *Motion* and *Circumvolution*, all *Modifications of Light*, or *Colours* do proceed. This is evident in *Tranſparent Bodies*, in which many *Colours* do appear, whereof no other Cauſe can be aſſigned, beſides thoſe different *Modes*, according to which the *Beams of Light* are admitted. As may be ſeen in *the Rainbow*, *Peacocks-Tails*, and in *the Necks of Doves*; foraſmuch as theſe *Colours* cannot be ſaid to be any thing elſe, but the *Light* it ſelf received in the outward-parts, and ſo or ſo reflected and conveyed to our *Eyes*. For all the *Particles* of *Light*, that enter a *Tranſparent Body*, are not drowned or ſwallowed up of it, but many of them rebound, which by means of various *Reflection* and *Refraction* reaching our *Eye*, do produce in us the *Senſe* of *Colours*.

This will appear clearly to us in the *Priſm* M N P, 2 of the *Surfaces* whereof, M N, and N P, are entirely plain or flat, and ſo inclined the one towards the other, as to conſtitute an *Angle* of about 30 or 40 Degrees; and therefore if the *Rays* of the *Sun* A B C, that *light* perpendicularly upon the *Surface* N P, do penetrate or pierce it obliquely about the *Hole* D E, which exhibits a *Shadow* at both parts of the ſaid *Hole*, to the *Rays* D F, and E H, paſſing through it; it is manifeſt by Experience, that the *Rays* paſſing obliquely through that Hole, from the *Glaſs* into the *Air* will be refracted, and reaching the *Surface* H G F, (which we ſuppoſe to be *White*) they will exhibit divers *Colours* from H to F, and that in this order: In the firſt place they will repreſent a *Blew* or *Violet Colour* about *H*; then a *Green*; in the 3*d* place, a *White* about G; 4*thly*, a *Yellow*; and 5*thly*, a *Red Colour* about F. Figure 69.

Now what happens in this Production of divers *Colours*, but only this, that the *Globuli* of thoſe *Rays*, which after the ſame manner of Inclination, falling upon the lower *Surface* of the *Priſm* N P, on the Left hand towards D N, have a *Shadow*, cauſed by the ſlow motion of the *Globuli* of the 2*d Element*; whereas on the Right, towards E P, they have a *Light*, cauſed by the ſwift *motion* of the ſaid *Globuli*; which cauſes them to move more ſwiftly about their own *Centers*, than they do in a Right *Line*.

For the better underſtanding whereof, let us ſuppoſe a *Ball* 1, 2, 3, 4, ſo ſtruck from V to X, as to proceed only in a right *motion*, and that 2 of its Sides 1 and 3, with equal ſwiftneſs fall down to the *Surface* of the *Water* Y Y, where the *motion* of the Side 3, which reacheth that *Surface* before the other, is retarded, that of the Side 1 being not changed at all; whereupon the whole *Ball* begins to roll about, according to the order of the *Figures* 1, 2, 3. Now this *Circumrotation* will be much ſwifter, than its *progreſs*, in caſe the *Ball* S, Figure 70.

being

VIII.

VIII.
Colour is
nothing
else, but a
Modifica-
tion of the
Rays of
Light.

Figure
69.

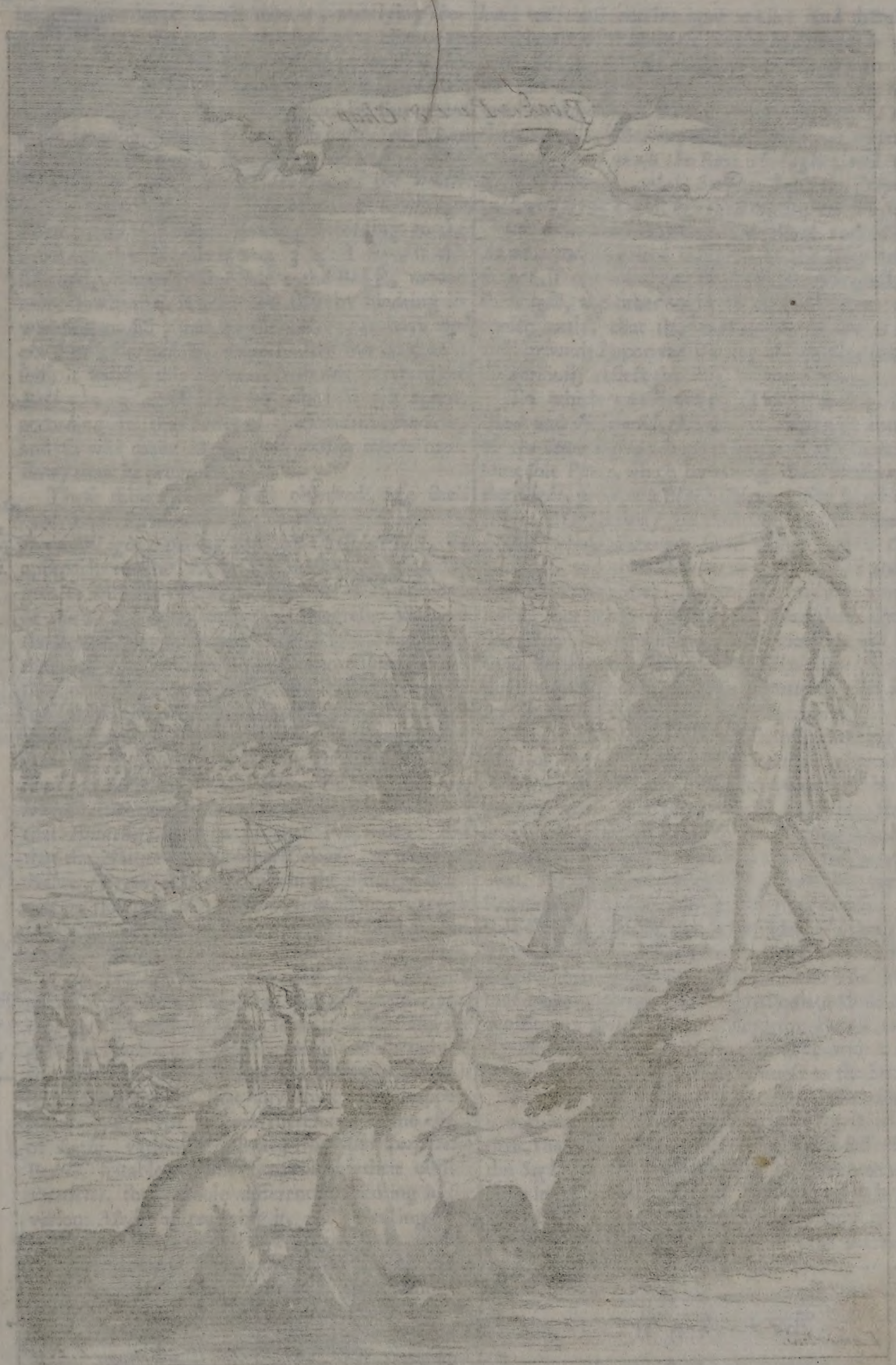

Figure
70.

To the Worship= full William
Upton of Lupton in the
County of Devon, Esq.

This Plate is humbly Dedicated by Richard Blome.

being moved more slowly than it, and lying beneath it, about the part of the *Ball* 3 2, chance to stop its progress; and that *Ball* Q, plac'd above it, about the part 4 1, being more swiftly moved, do forceably push it forwards, and by this means make its rolling about to be much more swift than its Progress. But if the *Ball* 1 2 3 4, falling slantingly from V, on the *surface* of the *Water* Y Y, towards X, and first touching it with its Point 3, do roll about slowly, according to the order of the Numbers 1 2 3 4: I say, if this suppos'd, it have on the Side 1 the *Ball* R, moved more slowly than it self, and thereby hindring its whirling round; and on the Side 3, it have oppos'd to it the *Ball* T, more swiftly moved than it self, it will by this its more swift *motion* retard the *Ball* 1 2 3 4, striving to whirl it self about, according to the Series of the foresaid *Numbers*, and so will make its *Circumrotation* much more slow, than its progress.

IX. *Whence the difference of Colours doth arise.*

These things being well observed, we shall easily understand, that by how much nearer the *Rays* of *Light*, passing through the *Hole* D E, do approach to the Left *Shadow* D, by so much greater will be the whirling about of the *Globuli* of the 2*d Element*, than their Progress: Whereas the nearer they approach to the Right *Shadow* E, they are whirled about so much more slowly, than they move fore-right. We understand likewise, that those *Globuli* which intersect the middle of that *Light* about G, have an Equal proportion of *Retardation* or *Acceleration* of their *Circumrotation* and *Procession*. And seeing that we find the *White colour* represented there, we must conclude that *Whiteness* consists in that *Proportion*: But that the Nature of the other *Colours*, as of *Blue*, *Yellow*, *Green*, *Red*, consists in the different swiftness or slowness of their *whirling* about, exceeding that of their Process, or moving forwards.

Figure 69.

X. *All Colours are true Colours, and none only apparent.*

I am not ignorant, that most *Men* distinguish these *Colours* from *true* ones, and call them *Apparent* only; but these do not seem to understand the genuine Nature of *Colours*, which consists only in this, that they *appear* and are conspicuous. For it is a contradiction, that any thing should appear and be false. All *Colours* therefore are the effect of *Light*, variously reflected from the *Surface* of *Bodies*, suitable to the situation of their outside *Particles*, their whole difference consisting in the various *Modes* of receiving it, and reflecting it to our *Eyes*. Thus we call that a *Black Body*, which extinguisheth and choaks the *Rays* of *Light*; and therefore *Black Bodies* carry a resemblance of *Darkness*. *Blue Colour*, which approacheth to the Nature of *Black*, is that which reflects only a few *Rays*: And 'tis for this Reason, that *Sea-water*, where it is deep and transparent, appears of a *Bluish Colour*; because there are but a few *Rays* reflected from its *Surface*, and none of those that penetrate the *Substance* of it, do return.

XI. *What a White Body is.*

A *White Body* is that, which reflects the *Rays* to the *Eyes*, in the same order as it receives them. Of this *colour* are all those *Opake Bodies*, whose *Surface* is so rough and rugged, that it reflects from all Sides the *Rays* it hath received *parallel*. So that in order to our having the Representation of a *White Colour*, we must receive many *Rays* from the *Object*; whereas for to see a *Black Colour*, we must receive none at all. And therefore the Nature of *Blackness* must consist in a property which *Black Objects* have, to drown and mortifie the *Beams* they have received, as we have mention'd before. So that we may conclude, that those are *Black Bodies*, *whose Surface is proper to extinguish and quash the Rays of Light*; and that those are *White*, *whose Surface hath the Property to diminish the Light, by reflecting it from all sides.*

XII. *Wherein the difference betwen Black and White Marble doth consist.*

But some may Object, that *Black* and *White Marble* consist, in a manner, of the same *parts*, so that if one of them swallows or extinguisheth the *Light*, the other ought to do so likewise; and consequently, that the variety of *Colours* is not well grounded upon the Variety of *Objects*, which do variously reflect the *Rays* of the *Sun*.

To which we Answer, That true it is, that *Black* and *White Marble* do, in a manner, consist of the same *Parts*; but yet in the *Black* there are some soft *Parts*, which by taking in or swallowing the *Light*, produce a *Black Colour*. For *Black* and *White Marble* may be compared to a *Pumice-Stone*, whose *Pores* are filled with a kind of *Oily Matter*, and the *White* to a *Pumice-Stone* that is only fill'd with *Air*. For it may easily be understood, that when *particles* of *Sand* dash against this latter, they will rebound presently; but not from the former, because the *Oily Matter*, that fills its *Pores*, doth quash their *motion*, and in a manner swallow them.

XIII. *What a Red Colour is.*

That is a *Red Body*, which in reflecting the *Rays* of *Light*, makes the *Particles* thereof to whirl strongly about their own *Centers*, in like manner as a *Ball* turns round by being struck against the *Earth*, or with the slanting stroak of a *Racket*. *Yellow*, *Purple* and *Green Colours*, proceed, as hath already been said, from this various Rotation of the *Particles* about their *Center*. So that the *Particles* of the *Subtil Matter*, that constitute a *Yellow colour*, are more slowly whirl'd about, than those that make a *Red*: And those that make a *Green*, more slowly than those that constitute a *Yellow colour*: And the *Purple colour* is nothing else, but mixture of a *Blue* with a *Red colour*, which imparts its brightness to the former.

XIV. *Colour is nothing else, but modified Light.*

From all which we may conclude, That *Colour* is nothing else, but *Light Modified*; for it is evident, that a *Coloured Object* cannot of it self affect the *Sight*, as being for the most part immoveable, or at least not reaching the *Eye*, where it is perceived; neither can any thing be thought of that moves the *Eye* at that time, but only the *Light* reflected from the *Body* seen.

CHAP. XVIII.

Of the Sense of Seeing.

I. *What the Sense of Seeing or Sight is.*

THe last in order of all the outward *Senses*, and the most Excellent of them, is the *Sight*; whether we consider the *Object* of it, or the manner whereby *Objects* are conveyed to the *Seeing Faculty*. For *Sight is a Sensation proceeding from a due and various motion of the Optick Nerve, made in the bottom of the Eye, by the Rays of Light coming from an Object, and from thence conveyed to the* Brain; *by means whereof the Soul perceives the illuminated thing, together with its Quantity, Quality, and Modifications.*

The *Sense* of *Seeing* begins indeed in the *Eye*, but is perfected no where but in the *Brain*, where the *Soul* is affected with the Impressions of visible *Objects*.

II. *What the Object of Sight is, and how many-fold.* The proper *Object* of *Sight* is every thing whereby the *Eye* becomes affected and changed, in order to the production of *Sensation*: And this *Object* is twofold, *viz.* *Light* and *Colour*; for these 2 cannot be perceived by any *Sense* but that of *Seeing*. And tho' some reckon up 5 several species of common *Objects*, *viz.* *Motion*, *Quiet*, *Number*, *Figure* and *Magnitude*; yet to speak accurately, *Light* only is the *Object* of *Sight*, whether the same proceed from the *Lucid Body*, through a transparent *Medium*, and so retain its own name; or whether it be reflected from *Opake Bodies*, and represent the *Image* of them; or whether in its *reflexion*, it be this or the other way refracted, and so affect the *Eye*, under the name and *Species* of *Colour*.

III. *The Order of things to be handled in this Article.* Forasmuch therefore as *Vision* or *Sight* follows from the Action of the *Object*, upon the inward and outward *Organs*; and since it is necessary that visible *things* should convey some *Images* to the *Eye*, and from thence to the *Brain*, Our Business will be in *this Chapter* to enquire; *First*, How, and in what manner *Rays* do proceed from the *Objects*. *Secondly*, How *Objects* imprint their *Images* upon the *Organ*; and *Thirdly*, How these *Images* are communicated to the *Brain*.

IV. *What Rays are to be considered in Vision, or with respect to the Sense of Seeing.* As to the *First* of these, we are to observe, that all the *Rays* that reach the *Apple* of the *Eye*, one of them always proceeds from the *Object* that is directly opposite to the said *Apple*, which passing through the midst of it, penetrates directly, and without any *Refraction* to the bottom of the *Eye*, or the middle of the *Net-like Coat*. And this *Ray* is commonly called the *Axis of Seeing*, or the *Optick Axis*. It is also called *Perpendicular*, because it enters straight into the *Apple* of the *Eye*; whereas the other *Rays* which recede from this middle *Ray*, tho' they enter the *Apple*, yet it is only slantingly or obliquely. So that the *Cone*, whose *Axis*, is the *Axis* of *Vision*, is the streighteſt of all, the others being more oblique, as they farther recede from it. This will be more clearly apprehended by the *Figure*.

Figure 78.

Let therefore K be the *Eye* before described, and the Object T R X. Now it is evident that *Rays* proceed from every point of this visible *object*. But forasmuch as those *Rays* only concur to the *Sense* of *Seeing*, that enter the *Apple* of the *Eye*, therefore we are only to consider those *Beams* which fall upon that part of the *Horny Membran*, which directly answer to the *Apple*. Wherefore since our business here is to enquire what the *Rays* are, whereby the point R, doth affect the bottom of the *Eye*, we shall only here consider those which proceed from that point, *viz.* R N, R L, and the middlemost between these two, drawn from R to S.

And because the Middle *Ray* R S, is perpendicular to the *surface* or outside of the *Eye*, therefore neither doth it suffer any *Refraction* by passing from the *Air*, into the *Watry Humour*, but passeth straight from R to S; for seeing that it falls perpendicularly upon the other intermediate parts of the *Eye*; it is necessary that it be directed in like manner to S.

But forasmuch as the *Ray* R N, doth not alight perpendicularly on the *surface* of the *Eye*, and being to pass from the *Air* into the *Water*, it is manifest that therefore it must suffer a *Refraction*, by approaching to the *Perpendicular* R S, and seeing that this *Ray* is not Perpendicular, whilst it passeth out of the *Watry Humour*, into a *Harder Body*, *viz.* the *Crystalline Humour*, it must a second time be refracted, and from thence entring into the *Glassie Humour*, which is softer, it must again be turned aside; and thus still approaching nearer to the *Perpendicular* R S, after many *Refractions*, it arrives at the point S. The same is also to be said of the *Ray* R S, which after having undergone some *Refractions*, joins it self to the 2 other *Rays*, that are united in the point S. And thus it appears how the *Object* R, acts after the same manner upon the Bottom of the *Eye*, as if it sent forth one *Ray* only, that might perform the same, which all those *Beams* do that are contained between F F.

V. *Rays flowing from divers points of an Object, fall upon so many points of the Retina, or Net-like Membran.* From what hath been said it will appear, what happens to those *Rays*, which from another point T, enter the *Eye*. For all the *Beams* that enter the *Eye* must undergo such *Refractions*, as that they may all of them be terminated and united in the point V. And therefore we may say, that the *Points* T R X, and any other intermediate ones, do all of them send their *Rays*, in a manner into one and the same *Point* of the Bottom of the *Eye*; and on the other hand, that every point of the Bottom of the *Eye*, receives only the impression of one Point of the *Object*. So that it happens, when ever we have a mind clearly and distinctly to view any *Object*, that we direct our *Sight*, or the *Axis of Vision* to every part of it successively, and so take a particular view of the whole *surface*.

VI. *How the disposition of the Eye comes to be changed.* Tho' the *Rays* only that proceed from *Objects* directly turn'd towards the *Apple* of the *Eye*, by passing through it, penetrate to the *bottom* of the *Eye*, yet may there be several other collections of the *Rays*, according to the different disposition of the *Organ*. As appears in *Old Men*, who have only a confus'd *Image* of *Objects* that are near them: And on the other hand, those that *look Asquint*, and have prominent *Eyes*, do more distinctly see things near at hand, and less exactly, such as are at a greater distance. The *Reason* of which difference is, because the *Eye* is of such a make or constitution, that according to the different distance of the *Objects* we have a mind to view, it may be extended, and so become *flatter*. Thus when we direct our *Sight* to any *Object*, that is too far distant, to be distinctly perceived by us, according to the ordinary constitution of our *Eye*, the *Eye* by means of the 4 direct or straight *Muscles*, is made plain or flat, because all of them draw it downwards to the bottom of the hollow wherein the *Eye* is placed; by which means the *Retina* approacheth near enough to the *Crystalline Humour*, to be present to the new Collection of *Rays* which proceed from one *Point* of the distant *Object*. And on the other hand, when we have a mind to direct our *Sight* to an *Object* that is too near to us, then our *Eye* becomes dilated by the help of the 2 *Oblique Muscles* that do encompass it, and being blown up or swell'd, by the introduced *Spirits* do press the *Eye*; whereby it comes

to

to pass, that the *space* which is between the *Crystalline Humour* and the *Retina*, becomes large enough for the *Rays*, which proceed from the Point of the near *Object*, to be again collected and united in the *Retina*.

VII. *Why Old Men see things that are near them, confusedly; and Squint-Ey'd persons, things that are far from them.*

Old Men therefore cannot exactly perceive *Objects* that are too near them, because their *Humours* begin to dry up, and their *Bodies* waste and grow learner, whereby the Convexity of the *Horny* and *Crystalline Humours* is diminished and so grows *flatter*, by which means the *Eye* becomes somewhat broader than it was in time of *Youth*. Now this *alteration* of the Parts of the *Eye*, doth not suffer the *Rays* proceeding from a near *Object*, and constituting the sides of *Cones*, to unite in the *Retina* it self, but make them pass on as if they would unite beyond it. Whereas those who *see Asquint*, and have prominent *Eyes*, do but imperfectly behold things at a distance; for their *Eyes* being longer and protuberant, the *Rays* that proceed from one point of the distant *Oject*, do meet before they come to the *Retina*, and afterwards spreading themselves, fall only upon a little part of the bottom of the *Eye*. And therefore those who have such prominent *Eyes*, do approach the *Object* to their *Organ*, to advance the too short *points* of the visive *Cones* to the *Retina*. For the nearer a thing is approached to the *Eye*, so much the more are the *Rays* thereof turn'd aside, and constitute shorter *Visive Pyramids* or *Cones*. But *Old Men* remove the *Object* farther from their *Eye*, that by making the points of the *Cones* longer, they may reach the *Retina*.

VIII. *Convex Spectacles are of most use to Old Men, as Concave Spectacles to Squint Ey'd persons.*

Hence it appears, that *Convex Spectacles* are most useful for *Old Men*; as on the contrary, Concave *Spectacles* are most helpful to such as are *Squint Ey'd*. For seeing that the former stand in need of having the *Rays* contracted, to the end that the points of the *Cones* may be brought to the *Retina*, this is effected by a *Convex Spectacle*: but whereas the latter stand in need of a greater dilatation of the *Rays*, thereby to advance the *Cusps* of the *Cones* towards the *Retina*, this is effected by a *Concave Spectacle*. For by the interposing of a *Convex Glass*, the *Rays* which before went to the *Rainbow*, and further, are by this means gathered into the *Apple of the Eye*, so that *Rays* are now received by the *Eye* from those parts that were hid before, and those which before were joined together, by the interposition of them, are made distant from each other, and consequently represent the whole *Object* bigger than indeed it is. But by the interposing of a *Concave Glass*, many *Rays*, which before entred the *Apple*, are thrust outwards to the *Rainbow*, or more outward parts; so that those parts which were separate before, do now unite, and by means of this contraction represent the whole Object less than it is.

IX. *How the Object forms its Image in the Eye.*

As to the *second, viz.* the forming of the *Image* of the *Object* in the *Organ*, it will not at all be difficult to conceive how this is done, supposing we do well apprehend that the *Object* acts only upon *one* point of the bottom of the *Eye*, *viz.* upon that which is directly opposite to it; and so likewise that one only point of the *Retina*, *viz.* the middlemost is affected by that one point of the *Object*. For the *Rays* that proceed from External *Objects*, at the bottom of the *Eye*, act upon some *Latitude* of the *Optick Nerve*, which as to the *Figure* doth as much resemble it, as the *Lineaments* of an Excellent *Painter*, drawn in a *Picture*, can be like him. Besides, there is another reason for this latitude of the *Retina* being like the *Object*, *viz.* because it receives so many impressions in all its parts, as there are different *Colours* or different degrees of *Light*, in all the parts of the *Object*. And because the name of an *Image* or *Likeness* is attributed to that thing, which hath some resemblance with the thing it expresseth; therefore we may well give this name to the *Latitude* of the *Retina*, on which all the *Rays* proceeding from the *Object* do fall; and consequently may affirm, that the *Object* doth pourtray its similitude or *Image* in the bottom of the *Eye*.

X. *This Image is not in all things like unto the Object.*

Neither are we to look for any more perfect likeness between the *Object* we behold, and its *Image*, than there is between the *Objects* and *Images*, that appear in a darkned Room, where only one little hole is left for the *Rays* of *Light* to enter, which are received at a convenient distance upon *white Paper* or a *Sheet*. For tho' in this case the *Images* of the *Objects* be very exactly delineated, and their *Qualities* sufficiently expresst, yet they appear inverst, so that the right parts of the *Object* are left in the *Image*, and those which were uppermost in the *Object*, are neathermost in the *Image*. As appears in the *Figure* before represented, where we find Y, which is on the left side, represents X, which is at the Right; and V, which is at the Right, T, which is at the Left. But how this comes about shall be shewed in the *next Chapter*.

XI. *How the Images of the Objects arrive at the Brain.*

As to the *Third* thing to be resolved how the *Resemblances* of *Bodies* are conveyed from the *Eye* to the *Brain*, this also will be easily apprehended, if we consider that these *Representations* pourtrayed in the *Eye*, and admitted to the place of the Extremities of the *Capillaments*, which compose the *Optick Nerves* are so impress't, as that the *Rays* touch those *Capillaments*, not according to their whole length, but only with their extremities. And because this impression which is made at the end of every *Capillament*, reacheth to the other, it cannot be otherwise, but that the whole *Image* of the *Object* must be conveyed to that place, where these *Capillaments* are terminated, that is, within the *substance* of the *Brain*. The *Rays* therefore that flow from the *Body* X, to the *Eye*, touch the end of some of the *Capillaments* of the *Retina* or the *Optick Nerve*, at the point Y, and those that come from the *Body* R, do in the point S, touch the Extremity of some other *Capillament*; and those that proceed from the *Body* T, the end of another V, and so on. And since *Light* is nothing else but *Motion*, or a *propension to Motion*, it is evident that all the *Rays* that are come from XRT, being of force enough to move the *Capillaments* YSV, are consequently of force enough to move the *Brain*. By which means an *Image* is again formed in the inward *surface* of the *Brain*, which faceth the Cavities thereof: For by the word *Image* nothing else is understood here, *than the various Motions of the Parts of the Brain*, and so likewise those represented in a *Looking Glass*, at the *Bottom of the Eye*, &c. are nothing else but such kind of *motions*.

But

XII. *How it comes to pass that only one Sensation is perceived in the Brain.*

But it may be you will enquire, how it comes to pass that the *Images* proceeding from *External things*, and entring the *Brain*, do not exhibit these two, but one only *Object*, when yet there be 2 *Optick Nerves* which equally convey the *motion* impress upon them?

XIII. *Answer.*

To this I answer, that there is a certain *Kernel*, in the midst of the *Ventricles* of the *Brain*, called *Conarion*, in which the 2 Images, proceeding from both the *Eyes*, are united, by means of those *Spirits* that fill the Cavities of the *Brain*. And this *Kernel* is called the Residence of the *Common Sense*, because the *Soul* immediately exerciseth its operations in it. When therefore at any time we behold an *Object*, by Example a *Flower*, the *Light* that is reflected from it, doth delineate 2 *Pictures* or *Resemblances* in each of our *Eyes*, and these draw 2 others, by the help of the *Optick Nerves*, in the inward *surface* of the *Brain*; which Representations being conveyed to this *Kernel*, do meet there, and are united; which *Kernel* consequently acting upon the *Soul*, represents to it the *Image* of that *Flower*.

XIV. *Why we assert this Kernel to be in the Midst of the Brain.*

Neither do we without good ground assert this *Kernel* to be in the midst of the *Brain*, as being the *Principal Seat* of the *Soul*, where all *Sensations* are performed. For we find that all the other parts of the *Brain* are double; as we have 2 *Eyes* to *see* with, 2 *Ears* to *hear*, and 2 *Hands* to *handle*, and the same may be said of the rest of the *Organs* of our *Senses*; and yet we *see* but one *Object*, and *hear* but one *Sound*, &c. wherefore it is necessary that both these *Images*, or rather *Motions* proceeding from 2 *Organs*, should meet together in one *place*, before they be considered of by the *Soul*. Neither is any such single part to be found in all the *Brain*, besides this *Kernel*, which is placed in the very midst of the *Ventricles* of the *Brain*, and consequently is surrounded by the *Spirits*, and therefore may well be accounted the seat of Common Sense, that is, of Cogitation, and therefore also of the *Soul* it self.

CHAP. XIX.

How Vision, or the Sense of Seeing is performed.

I. *The Soul feels or is sensible by means of the motion of the Nerves.*

HAving thus explained how the *Light* is transmitted through the *Humours* of the *Eye*; how *Objects* communicate their *Images* to the *Organ*, and how the said *Images* enter the *Brain*; it remains now that we explain, how this *Image*, communicated to the *Brain*, doth produce that *Sensation* in us, whereby we are said to *See*; and in the next place what are the Causes of the *Clarity* and distinction of our *Sight*; and Lastly, how the *Qualities* of *Objects*, *viz.* their *Situation*, *Distance*, *Magnitude*, *Figure*, *Motion* or *Rest*, are thereby discerned. Now that we may the better understand how this *Spiritual Image* is delineated in us, we are to call to mind, what hath been before handled *Chap.* X. §. 6. *viz.* that such is the Nature of our *Soul*, that by the force of those *Motions*, which are impress on that part of the *Brain*, whence the thin Capillaments, or *Hair-like Strings* of the *Retina* derive their Original, various *Sensations* are excited; so that the whole difference of them depends on the various *motion*, which every part of the *Object* doth excite. Thus the *Soul*, by occasion of some *motions* that are made in the *Nerves* which belong to the *Ears*, perceives *Sounds*; and by means of the *motion* of those *Nerves*, that assist the *Organ* of *Tasting*, and act immediately upon our *Soul*, the *Sense* of *Taste* is stirr'd up in us, and so of the rest.

II. *What the Images of Objects are.*

For these Impressions are nothing else, but various *motions* of the parts of the *Brain*, and of the *Animal Spirits*, affecting the *Glandula Pinealis* or *Pine-Apple-like* Kernel; to which when the *Soul* of *Man* attends, he discerns visible *Objects*, tho' these *motions* are not like the *Objects* which they represent. Just after the same manner as one that *walks* in the *Dark*, or is *blind*, distinguisheth *Objects* by means of a *Stick*, tho' neither the *Stick*, nor its *Motion* bear the *Image* of them. Or as *Words written* or *spoken*, serve to convey the knowledge of things to us, tho' they be no resemblances of the *things* they bring to our *Minds*.

III. *How it comes to pass that some Objects appear more clearly than others.*

It is manifest therefore, that the sight of any thing will be more clear and lively, according as there are more *Rays* proceeding from the *Object*, and entring the *Eye*: For by this means the impression made upon the *Capillaments* of the *Optick Nerve* is the stronger. The largeness of *the Apple of the Eye*, conduceth also to this purpose, by giving way to many *Rays*, proceeding from the same point of the *Object*, to enter the *Eye*, in order to the representing of its *Image* in the bottom thereof. Hence it is that we dilate and open the *Apple* of our *Eye* more in viewing a distant *Object*, than one that is near us; because then more *Rays* enter the *Eye* from the several *points* of it, than when we do straiten it and make it less. And for this reason it is that remote *Objects*, appear more clearly to us, than such as are very near to us, and the *Colours* of those appear more lively, but of these more dull and weak.

IV. *What is the Cause of the Distinction of Vision.*

As to the *Distinction* of *Sight*, whereby the parts of the *Object* are discerned in their proper *Place*, *Situation*, *Figure* and *Colour*, it is certain that the same proceeds from the *Refraction* of *Rays*. Now to the end that the *Sight* of any *Object* may be very distinct, and admit of no confusion at all, it is necessary that all the *Rays*, which from the same point of the *Object*, are directed to the same point of the *Horny Membran*, be so refracted, as that they may at last meet and be united in the point of the bottom of the *Eye*. But seeing that this doth not happen, save only in those *Rays*, which proceed from that point of the *Object*, in which the *Axis* of *Vision* is terminated, it so happens that at that time, we can only have a distinct Sensation of that part, and of the rest a confused and indistinct view.

V. *The other Cause of Distinct Seeing.*

The other cause of *Distinct Vision*, depends on the *Capillaments* of the *Optick Nerve*; for seeing that we cannot discern the parts of *Bodies* we do behold, but only inasmuch as they are distinguisht by *Colour*, and that the distinct perception of these *Bodies*, doth not only depend upon this, that all the *Rays* which proceed from the several *points* of *Bodies*, do in the bottom of the *Eye* meet in about so many other *points*; but is also caused by the multitude of the *Filaments* of the *Optick Nerve*, the Extremities or Ends whereof are contained in that space, which the *Image* at the bottom of the

Eye

Eye doth take up; it follows that there muſt be ſo many ends of theſe *Capillaments*, as there are ſenſible parts in the *Object*, that reflect their *Rays*. For if the *Rays* proceeding from 2 different *parts* of the *Object*, ſhould meet in 2 divers points of the ſame *Filament* ſeparately, it would be the ſame as if they met in the ſame *Point*, becauſe they could not move that one *Filament* after 2 ſeveral manners. Whence it is that *Fields*, in the *Summer-time*, abounding with *Red* or *Yellow Flowers* that grow amongſt the *Graſs*, do ſeem to be wholly *Red* or *Yellow*; becauſe both the *Graſs* and *Flowers* acting together upon one and the ſame *Capillament*, the *Flowers* which are of a more lively *Colour*, do only appear to the *Eye*, becauſe that *Filament*, at that time only follows the motion, which the *Flowers* impreſt upon it.

VI. *How the Situation of the Object comes to be diſcerned.*

The *ſituation* of *Bodies* is not perceived by any *Repreſentation* or other *Action*, proceeding from them, but only by the Impulſe, coming from a certain *Region* or quarter, to ſome particular part of the *Brain*. For the *Object* ſeems to be ſituate in that part, from whence the *Rays* come that affect the *Eye*. Thus we ſuppoſe the *Candle* A C, to be placed in ſuch a quarter, becauſe the *Eye* B D E, doth from thence receive the *Rays* that make an Impreſſion upon it, which Impreſſion gives occaſion to the *Soul* to judge that the *Candle* A C, takes up ſuch a ſituation amongſt other *Bodies*. For the knowledge of the ſituation of any thing depends only on the ſituation of the *particles* of the *Brain*, from whence the *Filaments* of the *Nerves* do ariſe: But foraſmuch as thoſe *Filaments* are diverſly affected by *Bodies* in different places, becauſe of their various diſpoſition, the *Soul* by their peculiar motion, diſcerns their different ſituations. Thus when we turn our *Head* or *Eye* this way or that way, the *Soul* is put in mind of that thing, by the Change which the *Nerves* inſerted in the *Muſcles* ſubſervient to that *Motion*, do effect in our *Brain*. For when the *Eye* B D E ſees the *Candle* A C, the *Soul* may know the ſituation of the ſaid *Candle*, becauſe the *Nerves* of the *Eye* partake of another diſpoſition, than if it lookt another way.

Figure 72.

VII. *Why the Image of an Object is turn'd upſide down in the Eye.*

Nevertheleſs it is to obſerved, that tho' *Objects* be perceived in their natural ſituation; yet their *Images* are turned upſide down in the *Eye*. The reaſon whereof is, becauſe but one of thoſe *Rays* that enter the *Eye* being *Perpendicular*, and Direct, and the reſt, becauſe of the ſtraitneſs of the *Apple* of the *Eye* entring obliquely, it happens that the Oblique *Ray* A B, proceeding from the upper part of the *Candle*, and the *Ray*, C D, flowing from its lower, do intercept one another, ſo that the lower part C, of the *Candle*, is repreſented at the bottom of the *Eye* upwards about D, and the upper part A, of the *Candle* appears about B, by which means the *Candle* is delineated in the *Eye* inverted. This any one can make an Experiment of, by taking the *Eye* of an *Animal*, deveſted of all its *Membrans* and *Muſcles* beſides the *Retina*; for ſuppoſing that this *Eye* be placed before the little hole of a *Darkened* Room, and the *Candle* A C, be ſet oppoſit to it, if then ſtanding in the *Room* we look into the bottom of the *Eye*, we ſhall ſee the *Image* turn'd upſide down.

VIII. *Things at a great diſtance appear higher*

This *inverſion* of the *Image* in the *Eye*, is the cauſe why things appear by ſo much higher as they are farther from us; becauſe *Rays* that proceed from things near to us, do reach the upper parts of the *Eye* or *Retina*; whereas thoſe that flow from *Objects* far diſtant, do come to the lower part of the *Eye*: And conſequently it is neceſſary, that the former ſhould appear Higher, and theſe latter Lower.

IX. *How the Diſtance of things is perceived.*

The Diſtance of *Objects* is diſcerned by the various *motions* that change the *Figure* of the *Eye*: For when we behold things at a Diſtance, the *Apple of the Eye* becomes more dilated, and the *Cryſtalline Humour* is ſomewhat withdrawn towards the *Retina*, and by this means the *Figure* of the *Eye* becomes more Round: whereas, when we view *Objects* that are near to us, the opening of the *Apple of the Eye* is leſſened, and the *Cryſtalline Humour* contracted, and thruſt outwards, by which means the *Eye* becomes more extended in length. And whilſt we thus change the *Figure* of our *Eye*, according to the various ſituation of the *Object*, an alteration conſequently happens in the parts of the *Brain*, Nature having ſo ordered it, that the *Soul* thereby might be informed of the diſtance of the *Object*.

X. *Other ways of diſcerning the Diſtance of Objects.*

The *Diſtance* alſo of *Objects* may be diſcerned by the diſtinct or confuſed *Repreſentation* of them, and ſo likewiſe by the ſtrength or weakneſs of the *Light*. Thus when we know the Bulk of a *Body* beforehand, its diſtinct *Figure*, and the Livelineſs of its *Colour*, this knowledge will help us to know the *diſtance* of it. The *Interpoſition* alſo of many *Bodies* between us, and thoſe *Bodies* which we behold, conduceth not a little to the perceiving of their *Diſtance*; becauſe the diſtance we imagin there is between them, ſerves us for a meaſure whereby to take the diſtance of the *Objects* we are viewing. Thus when the *Moon* is very high raiſed above the *ſurface* of the *Earth*, it ſeems nearer to us when no viſible *Bodies* interpoſe between us and it, than when many *Terreſtrial Bodies* intervene. The *ſtrength* alſo and *weakneſs* of the *Light* are of uſe to inform us of the Diſtance of *Objects*: For *Bodies* illuſtrated with a weak *Light*, are apprehended to be at a greater diſtance, and thoſe things to be nearer to us which are ſeen diſtinctly, and under a ſtrong and vigorous *colluſtration*. And therefore it is that towards *Night*, or in *miſty Weather*, things that are near appear as if they were at a diſtance from us.

XI. *How the Bulk of the Object is perceived.*

By perceiving the *Situation* and *Diſtance* of every *Object*, we are informed of the *Bulk* and *Bigneſs* of it: Thus when the *Rays* from A and C, are decuſſated, or interſect one another at the *Apple of the Eye* E, the *Objects Angle of Viſion* being known, the *Soul* by this Impreſſion, being informed of the length of theſe *Rays*, eaſily diſcerns the Quantity of the line A C, which is the Magnitude of the thing. So that if ever the Mind miſtake in judging of the *Bulk* of any thing, it is only becauſe it hath not rightly perceived the diſtance of it. As it happens to a *perſon*, who not being able to conceive the great diſtance there is between the *Sun* and the *Earth*, will never know the true *Magnitude* of the *Sun*. And this is the Reaſon why the *Sun* and *Moon*, when they are neareſt to the *Horizon*, appear *bigger* than when they are farther from it; which doth not happen becauſe they ſometime appear under a greater, and at other time under a leſs *Angle*, but becauſe they are judged to

be at a greater distance. For our *Modern Astronomers*, who have measur'd the *Angle* under which the *Sun* or *Moon* appear at their *Rising* and *Setting*, find it to be the same with that under which it appears about the *Meridian*.

XII. *How the Figure of Objects is perceived.*

We judge of the *figure* of any *Object*, from the knowledge or opinion we have of the *situation* of the different Parts of it, and not at all from the likeness of the *Images*, that are delineated in the *Eye*; forasmuch as those *Images* are often *Elliptical*, and of an *oblong Square*, which represent to us *Objects* that are perfectly *Round* and *Equilateral Squares*. Thus *Square Objects*, that are at a great distance from us appear *Round*, because the great distance of the *Angles* obliterates the Jettings-out and Unevenness of the *Object*. In like manner, *Round* or *Concave Bodies* appear with flat and even *Surfaces*, because the *rising* or *depression* of any of the Parts, by reason of the great distance, escapes the *Eye*. Thus he who beholds the *Sun*, doth not discern it to be round, but flat, tho' indeed the middle parts thereof be nearer to our *Eyes*, than those that are towards the *Edges*: but so vast is the distance between the *Sun* and our *Eye*, that the foresaid proximity of the middle Parts, is not at all considerable or perceptible.

XIII. *How the Motion or Rest of Bodies is perceived.*

Lastly, *Motion* is perceived when the *Images* of *Objects* impress on the *Eye*, do run through several Spaces in the *Retina*, and successively answer to other *Images* of *Objects*, which we look upon as immoveable. Or when the *Eye* is fain to turn it self, that it may continue to have the *Sight* of the *Object*. So likewise the *Rest* of Visible things is perceived, when the *Eye* continuing without *Motion*, the *Images* represented in the *Retina* are at *Rest*, and continue to have the same Respect to another *Object*, which is consider'd as without *motion*.

XIV. *There must be a due Distance betwixt the Object and the Eye.*

Moreover it is to be observed, that in order to the due and right *seeing* of any *Object*, there is required a due distance, to the end that the many *Rays* that proceed from the several Points of the *Object*, may meet together in every least part of the *Retina*. As likewise, that the *Image* of the *Object*, may be represented in the bottom of the *Eye* sufficiently great and perceptible. Otherwise if the *Object*, for Example D, be too near, the *Rays* that proceed from it, as A B C, will enter so obliquely into the *Convex Surface* of the *Eye* A C, that the *Retina* E cannot be affected by them, as not being sufficiently gathered together. Wherefore since the meeting of the *Rays* is only in F, it is no wonder if no perceptible *Image* of the *Object* be delineated in the bottom of the *Eye*. Forasmuch as the Action of *Seeing* cannot be performed, except the *Rays* entring the *Apple* of the *Eye*, and being refracted at their meeting with the *Membrans* and *Humours*, strike upon the *Retina*, and impress the *Image* of the *Object* upon it.

Figure 73.

XV. *The too great distance of the Object produceth only an obscure Vision.*

But when the *Object* is at too great a distance, the contrary happens; for seeing that then only a few *Rays* proceed from every Point of the *Object*, and that those that come from them, do too much approach to a *Parallelism*, it so happens that they are united before they reach the *Retina*; and presently after separating themselves again from that Point of their meeting, cannot sufficiently move or agitate the *Retina*; whereupon only an obscure *Image* of the *Object* is represented. By Example, If the *Object* A be supposed to be far distant from the *Organ*, it is evident that only a few *Rays* will flow from each Point of it; and that the *Rays* A B, A C, A D, proceeding from each Point of it, by their inclining too much to a *Parallelism*, will unite about E, before they come to the *Retina* F. Whence it will follow, that either a too little *Image* of the *Object* will be drawn at the bottom of the *Eye*, or none at all.

Figure 74.

XVI. *What a Telescope or Prospective-Glass is, and how Objects at a distance are perceived by it.*

To prevent this defect, a *Telescope* or *Prospective Glass* is employ'd (that is, an Instrument whereby the *Visive Faculty* is assisted to discern *Objects*, that are at a great distance distinctly) which consists of 2 *Glasses*, *viz.* a *Convex* and a *Concave*: For by the first of these the *Rays* are so gather'd, that before the union or *coition* of *Cones* like to those which are produced by the *Eye*, the *Concave* intervenes, which by somewhat dilating of these *Cones*, doth advance their *Points* or *Cusps*, and renders them more distinct; so that being received into the *Apple* of the *Eye* after *decussation*, they again meet in the *Retina*, and according to the proportion of the *Convexity*, represent the thing greater. Wherefore, if such an *Instrument* be duly applied to the *Eye*, it makes the *Rays* that are gather'd about E, and afterwards scatter'd again in the *Retina* F, become gather'd in it, by means of the *convexity* of the *Eye*, and so produce a distinct and exact Vision or *Sight*. For the *Telescope*, by reason of its great *Pupil*, makes the Object to be seen by many *Rays*, and because of the *Convex figure* of the outward *Glass*, which congregates the *Rays*, it appears under a greater *Angle* of *Vision*. This *Instrument* causeth also a great *decussation* of the *Rays*, which enter the Round outward Extremity of the *Tube*, towards the *Retina*; and by this means a great Representation or Image of the *Object*, is delineated in the *Eye*, so that things at a distance appear great and distinct.

XVII. *Of the Deception of the Sight.*

How liable we are to be deceived by our *Sight*, as well as by our other *Senses*, will be evident to us by considering the manner how all our *Sensations* are formed, and more particularly that of *Seeing*. For hence it is, that some *Objects* appear more clearly to us than others; and that their *Place*, *Situation*, *Figure*, and *Colours*, are not always distinctly represented; that their *Bulk* seems sometimes greater, and at other times less; yea, and sometimes they are altogether *invisible*, especially those Parts that make their *Essential constitution*. In the *Bud* of a *Tulip-Root*, with a *Microscope*, we may easily discover the *Leaves*, which afterwards turn *Green*, those which are to compose the *Flower* it self, and that little Triangular part which contains the *Seed*, with the 6 little *Pillars* that surround it, at the bottom of the *Tulip*. And the same may be said of the *Bud* of a *Mustard-Seed*, of the *Kernel* of an *Apple*, and generally of all sorts of *Trees* and *Plants*: For tho' nothing of all this can be perceived by the *Eyes*, no not when assisted by a *Microscope*; yet we may with confidence conclude that they are all contain'd in the *Bud* of their *Seeds*. This may also appear in little *Animals*, as in the *Mites* that breed in *rotten Cheese*, and those little *Worms* that gnaw the *Skin*, and cause the

the *hands* to *itch*, which have all of them *Organical Bodies*, as well as any other *Animals*. And as we ſee in the *Bud* of a *Root* of the *Tulip*, the whole *Flower*, ſo likewiſe we may perceive in the *Treadle* of an *Egg*, which the *Hen* hath not yet ſit upon, a *Pullet*, which it may be is wholly formed. So likewiſe *Frogs* may be perceiv'd in the *Spawn* of *Frogs*. To which add what *Malbranche* aſſerts, that probably there are infinite *Trees* in one only *Bud*, and that all the *Plants*, and all the *Bodies* of *Man* and *Animals* that ſhall ever be, have been produc'd from the beginning of the *World*. Now it is certain, that all theſe things cannot be perceived by our unaſſiſted *Eyes*; yea, and that the greateſt part of them cannot be perceived with the help of the moſt excellent *Microſcopes*: And much leſs by our other *Senſes*, which the *Sight* excells in *order*, *dignity* and *extent*. Neither muſt this ſeem any whit ſtrange unto us, foraſmuch as it is only the *Surface* of *Bodies* that affects our *Senſes*, and that it is not their whole *Surface* neither that is capable of affecting our *Senſes*, but thoſe Parts only of it that are big enough to move the *Fibres* of the *Nerves*. And foraſmuch as thoſe Parts which make up the Eſſential Conſtitution of the *Body*, are very often too ſmall to move the *Fibres* of the *Nerves*, that belong to the *Organs* of *Senſation*; it muſt follow that they are hid from us, and that the *Object* which we perceive, may be quite different from what it appears to be.

XVI. *What a Teleſcope or Preſpective-Glaſs is, and how Objects at a diſtance are perceived by it.*

CHAP. XX.

Of Waking, Sleep, and Dreams.

I. *How Sleep is diſtinguiſh'd from Waking.*

NExt after the *Senſes*, it ſeems proper to treat of *Waking* and *Sleep*, foraſmuch as by theſe their *Operations* and *Ceſſations* are determin'd. For *Waking is the free Exerciſe of the Senſes, depending on the uninterrupted influence of the Spirits into the Organs.* And therefore thoſe things which increaſe the *Animal Spirits*, or do more ſtrongly agitate them, are the Cauſe of *Waking* or *Watchfulneſs*. *Sleep is a Binding of the Senſes, proceeding from the want of Spirits.* Wherefore thoſe things which diminiſh the *Spirits*, or foreſlow their *motion*, provoke *Sleep*. So that *Waking* and *Sleeping* differ no otherwiſe, than as *Looſing* and *Binding*, or as the *Flowing* or *Standing* ſtill of the *Water* that is in a *River*. For if we give heed to our own Experience, we know nothing elſe of *Waking*, ſave that it is ſuch a ſtate, wherein we hear the *Voices* of thoſe that *ſpeak* to us, *ſee* viſible *Objects*, are moved by the things that *touch* us, and are ſenſible otherways of thoſe thing whereof our *Nature* is capable. And as to *Sleep*, we experience it to be a ſtate oppoſite to this, and wherein we are not excited by the *Objects* wont to ſtrike our *Senſes*, but our *Body* reſts as depriv'd of all *motion*.

II. *Wherein the State of Waking or Watchfulneſs conſiſts.*

To the end therefore, that we may be able to give an account of both theſe *States*, we are to obſerve, that the *ſtate* of *Waking* conſiſts in this, That the *Animal Spirits* (which as was ſaid before, are the moſt lively parts of the *Blood*) being in great abundance in the *Brain*, are eaſily determin'd by the *Glandula Pinealis*, to flow into the *Nerves*, and fill them ſo, that all their *Capillaments* are kept ſtretched or diſtended, and ſeparate from one another. For ſuppoſing this affluence of the *Spirits* in the *Brain*, if any *Object* acts upon our *Body*, it may be eaſily conceived, that the *Capillaments* of the *Nerves*, that terminate towards that Part, will convey the *motion* they have received, to that very part of the *Brain*, which immediately ſtirs up the *Soul* to *Senſation*. For it cannot be difficult for us to imagine, that the *Animal Spirits*, which are then determin'd towards certain *Muſcles*, cauſe thoſe Parts of the *Body*, in which the *Muſcles* are inſerted to be moved. So that *Waking* or *Watchfulneſs is* nothing elſe, but *the Dilatation of the Animal Spirits in the Brain, and throughout all the Nerves, whereby the Organs of the Senſes are at full liberty to tranſmit the motions of the Objects to the Common Senſe, placed in the midſt of the Brain.*

III. *The Cauſes of Waking or Watching.*

Watching may be effected by many Cauſes. *Firſt*, By thoſe things which thin the *Blood*, or which over-heat it, and by agitating it too much, increaſe the *Animal Spirits*. *Secondly*, By things which open the *Plexus Choroides* of the *Arteries*, and ſo make way for the *Spirits* to enter into the *Nerves*. *Thirdly*, By things that ſtir and *agitate* the *Body* over-much, and by making the *motion* of the *Blood* more ſwift, occaſion a greater Briskneſs and Livelineſs in the *Body*. *Fourthly*, By Moderate *Sleep* or *Reſt*, which recruit the *ſtrength* of the *Body*, and make it with more agility and chearfulneſs to perform its Task.

IV. *Wherein the State of Sleep conſiſts.*

Sleep being the State that is oppoſite to *Watching*, and wherein the outward *Senſes* are bound up, and ceaſe from their *Functions*, we ſhall eaſily underſtand how it is effected, by aſſigning a different diſpoſition to the *Brain*, from that which *Watching* doth produce. Foraſmuch therefore as the State of *Waking* doth conſiſt in the great abundance of the *Animal Spirits*, which repleniſh the *Ventricles* of the *Brain*, and the *Pores* of the *Nerves*: *Sleep* on the contrary muſt conſiſt in a *deficiency* and *want* of the ſaid *Spirits*, which cauſeth the *Pores*, through which the *Animal Spirits* are wont to flow into the *Nerves*, to grow limber and cling together, and being no longer diſtended by the copious afflux of the *Spirits*, to be ſhut up. For where this Obſtruction happens, the *Animal Spirits*, which before were contained in the *Nerves*, are diſſipated; and there being no other in a readineſs to ſupply their places, the *Filaments* of the *Nerves* cling together: So that if in this State an *Object* ſhould act upon any part of our *Body*, yet can it not tranſmit that Impreſſion to the *Brain*, and conſequently no *Senſation* can reſult from thence. Beſides, the *Muſcles* being then empty and void of *Spirits*, become limber and flagging, and ſo cannot be of any uſe for the *motion* of the *Members* to which they belong, nor keep the *Body* in an upright poſture, any more than if they were quite vaniſh'd. And accordingly in *Sleep*, the *Body* lies along, the *Eyebrows* fall, the *Head* nods, the *Knees* fail, and and all the *Senſes* ceaſe from their Actions. And therefore *Sleep is* nothing elſe, but *a relaxation of the Ventricles of the Brain, and a flagging of the Nerves, proceeding from the want of Animal Spirits, whereby the Organs of Senſe are at a ſtand, and unfit to convey the motions of the Objects*

XVII. *Of the Deception of the Sight.*

Objects to the Brain, and to the Common Senſe.

V. *The Opinion of the Peripateticks concerning Sleep.*

But whence this Effect doth proceed, and what that Band is, whereby the *Actions*, as well of the *Inward* as *Outward Senſes*, are ſuppreſt and bound up, is not ſo eaſie to determine. 'Tis a common Opinion amongſt *Philoſophers*, eſpecially thoſe that follow *Ariſtotle*, That *Sleep* is cauſed by the *Vapours* proceeding from the *Chyle* and other *Humours* working in the *Stomach*; which being afterwards condenſed, cloud the *Brain*, and cauſe Drowzineſs and Dulneſs.

VI. *This Opinion rejected by thoſe that hold the Circulation of the Blood.*

But this Opinion is not approv'd of by them, who hold the *Circulation of Blood*. For theſe cannot diſcover, by what ways theſe *Vapours* elevated from the *Stomach*, ſhould through ſo many of the *Inward parts* and *Bony priſons*, as through ſo many Obſtacles, be carried up to the *Brain*; foraſmuch as their Opinion is, that the moſt part of thoſe *Humours* that moiſten the *Brain*, is tranſmitted through the *Arteries*, and immediately communicated to it from the *Maſs* of *Blood*. Beſides, if *Sleep* be owing to the *Vapours* that ariſe from the *Stomach*, why is it not always conſequent to the taking in of *Food*; and why is not *Watching* always the Effect of our abſtaining from *Meat*? When yet we frequently experience the contrary, that many times with an *Empty Stomach* we fall into a *Deep Sleep*; and when we have eaten freely are inclin'd to be watchful. Moreover, *Children* are apt to fall *aſleep*, by *Wearineſs*, *Singing*, *Darkneſs*, and the *Rocking in a Cradle*; and yet none of theſe contain any thing of theſe *Vapours*, that are ſuppos'd ſo neceſſary for the cauſing of *Sleep*. To which may be added, that if a Ligature be put upon the Inward *Jugular Arteries* or *Veins* of any perſon, he will preſently fall *aſleep*; which is the Reaſon that thoſe who are hanged, ſeem to themſelves, as it were, to fall *aſleep*, as ſoon as they are turn'd off.

VII. *The true Cauſe of Sleep.*

Wherefore the Cauſe of *Sleep* is not to be attributed, to the *Fumes* and *Vapours* that ariſe from the *Stomach*; but rather to the *deficiency* of the *Animal Spirits*, or the *diminution* of their *motion*. For *Opium*, *Poppy*, *Mandrakes*, and other ſuch like *Sleep-provoking Medicaments*, do not produce their *Effects* by raiſing copious *Exhalations* from the *Chyle* to the *Brain*; but becauſe they hinder the motion of the *Spirits* that way, and by their *Fuliginous Humour* ſtop the *Spirits* that are contained in the *Brain*, from being conveyed to the outward *Membrans*. And accordingly *groſs Meats*, and *hard of Digeſtion*, which oppreſs the *Stomach*, commonly cauſe *Sleep* and Drowzineſs; becauſe they do fix and dull the *Spirits* contained in the *Stomach*, and by the conſent and correſpondence there is between that part and the *Brain*, make the *Spirits* there more dull and heavy.

VIII. *During Sleep, our Blood is hotter than when we are awake.*

But yet foraſmuch as the *Spirits* can never be without a conſiderable degree of *Agitation*, and can never be ſo far dulled, as to be deſtitute of all *motion*, it muſt follow that not being now employ'd to keep the *Body awake*, they muſt needs increaſe the *motion* of the *Blood* wherewith they are mingled; and therefore we find, that the *Body* is much hotter whilſt *aſleep*, than when *awake*: For we find, that in the Coldeſt Weather in the *Winter*, our *Bodies* are very hot when *aſleep*, but are no ſooner awake, but we need *Fire*, or ſome ſtrong and violent Exerciſe to preſerve us from being ſenſible of extream *Cold*, and the rigour of the Weather.

IX. *How Sleep comes to ceaſe.*

Sleep is diſcuſt either by *force*, or of it ſelf: The former way is, when the *Organ* of any of the *Senſes* is ſo ſtruck, that the impreſt *motion* arrives at the *Brain*; becauſe by this means the *Spirits* that are in the *Brain* may be ſo agitated, that joyning themſelves with others that are carried that way, they may produce *Waking*. And *Sleep* ends of it ſelf, when the *Animal Spirits*, which the *Blood* doth produce whilſt we are *aſleep*, are in ſuch abundance conveyed to the *Brain*, that opening the Paſſages of the *Nerves*, and ruſhing into them, they diſtend the *Filaments* thereof, and by this means give the *Soul* occaſion to perceive the ſeveral *Objects* that touch and affect the *Body*.

X. *What a Dream is, and what the Cauſe of it.*

The *Imaginations* of thoſe who are *aſleep*, are called *Dreams*, when the *Soul*, while the *Body* is *aſleep*, apprehends things, and diſcourſeth of them, as if it were *awake*. Now this happens, when during *Sleep* the *Animal Spirits* enter theſe Foot-ſteps, that were before impreſt on the *Brain*, moving ſome Parts thereof in the ſame manner, as they are wont to be moved by the preſence of an *Object*, acting upon the *Organ* of the *Senſes*.

XI. *How Dreams are produc'd.*

For notwithſtanding that in *Sleep*, the greateſt part of the *Pores* or Paſſages of the *Brain*, are ſtopt up by a *thick Vapour*, or rather *Humour*; and that the *Fibres*, by reaſon of this Obſtruction, become leſs active, eſpecially thoſe by which the *affection*, or impreſt *motion*, is conveyed from the outward *Senſe* to the inward, and from the *Plexus Choroides*, to the bottom of the *Brain*, and *Original* of the *Nerves*; yet the reſt may notwithſtanding this diſcharge their Function, at leaſt in part; which is the Cauſe why *Imaginations* are eaſily excited in us whilſt we are *aſleep*, by the leaſt motion or impreſſion from the *Blood*, *Gall*, or *Phlegm*, or of thoſe *Vapours* that are the Cauſe of the foreſaid Obſtructions, which make the *Fibres* ſo torpid and unactive. And this is the reaſon why things are but confuſedly repreſented to us, whilſt we are *aſleep*.

XII. *The Cauſe of the difference of Dreams.*

The difference and great variety of *Dreams*, proceeds *firſt* from the variety of the Foot-ſteps of former *motions* impreſt upon the *Brain*. Thus we find frequently, that the things wherewith we have moſtly entertained our *Thoughts* in the *Day-time*, are apt to be repreſented to us in *Dreams* by *Night*. *Secondly*, From the peculiar temperament and complexion of the *Body*, and the difference of *Meat* and *Drink*, whence the *Spirits* are generated. Thus *Perſons* of a *Cholerick Temperament* dream of *Quarrels*, *Fightings*, *Fires*, *&c.* *Phlegmatick Perſons*, of *Water-floods*, *Drowning*, *&c.* *Thirdly*, From *Cuſtom*; which being a kind of *ſecond Nature*, hath its effect upon us even during *Sleep*.

XIII. *Dreams are formed from things that are ſeen.*

Foraſmuch as the Parts of the *Brain*, which have been before moved by the outward *Action* of the *Object*, are more eaſily moved than thoſe that have been in continual *Reſt*: Therefore it commonly happens that the *Animal Spirits* puſh againſt them; ſo that we ſeldom *dream* of any other things, but ſuch as we have perceived by ſome

Senſe

Sense or other whilst we were *awake*. And accordingly we find but little difference, between the things we behold *waking*, and those which appear to us in *Dreams*; and that there is much the same succession of our *Imaginations* in our *Dreams*, as when we are *awake*, which tho' they seem sometimes incoherent, yet is there commonly some hidden connexion between them.

XIV. *How it comes to pass that our Dreams are sometimes strange and irregular.*

But because the *Objects* that are represented to us whilst we are awake, are in great number, and may variously affect the same parts of the *Brain*, it would be strange, if in the interval that is between *Sleeping* and *Waking*, the *Spirits* that are continually ranging through the *Pores* of the *Brain* should not *promiscuously* move some of the parts of it, that is, partly as they were moved at the presence of one *Object*, and partly as they were at the presence of another: and by this means it may come to pass that the *Soul* may perceive a monstrous representation, as of a *Goat* with a *Lions Head*, or the like; so that we have no reason to look for any Connexion or Order in our Dreams.

CHAP. XXI.

Of the Appetite of Hunger and Thirst.

I. *Why Hunger and Thirst are called Natural Appetites or Desires.*

SEeing that *Hunger* and *Thirst* are perceived after the same manner, as the other *Senses*, *viz.* by the *Ministry* of the *Nerves*, which like so many fine *Threads* proceed from the *Brain* to the *Stomach* and *Gullet*; it seems convenient that having spoken of the *Senses*, we should now proceed to explain what *Hunger* and *Thirst* is. Which 2 *affections*, are commonly called *Natural Appetites*, because they suppose a Compound of *Soul* and *Body*, and are generally accompanied with a desire to *Eat* and *Drink*.

II. Aristotle's *Opinion concerning Hunger and Thirst.*

ARISTOTLE defines *Hunger* to be a *desire of that which is hot and dry*; but does not take notice whence this *Appetite* doth arise, nor how it comes to be stirred up; nor do I believe that any of his *Qualities* will be able to explicate the nature thereof. For we find that *Infants* and other new born *Animals* desire *Milk*; but who will say that the *Appetite* to *Milk* is only the desire of that which is dry? Or shall we say that *Animals* when they desire *Herbs* and *Fruits*, are carried out with an *Appetite* to that which is *Hot* and *Dry*, when a moisture can be separated from them, which far surpasseth their *dry substance* in quantity? Again, how can *Hunger* be said to be the *Appetite* of that which is *hot* and *Dry*, seeing that *Herbs* and *Fruits*, according to all that we can perceive by them, have more *cold* than *heat* in them?

III. *What Hunger is, and how it is caused.*

Hunger therefore is nothing else but *a Sense arising in the Ventricle, from an Acid Juice twitching the Nerves thereof.* For as the various motions of the *Optick Nerve*, makes the *Soul* to perceive and discern all the varieties of *Light* and *Colours*; so there is nothing that can produce the sense of *Hunger*, but the *motion* of some *Nerves* inserted into the *bottom* of the *Stomach*. For the better understanding how this is done, we are to take notice that when the *Stomach* is empty of *Food*, the *Juice* or *Liquor* which is wont to flow out of the *Arteries* into the *Stomach*, and there to mingle with the *Food*, finding no matter to work upon, twitcheth the *Nerves* of the *Stomach*, which motion being conveyed to the *Brain*, stirs up the *Sense* of *Hunger*.

IV. *No Liquor is conveyed out of the Spleen into the Stomach.*

Some *Physicians* are of opinion, that this *Liquor* is conveyed into the *Stomach* by *Veins* from the *Spleen*: But that they are mistaken herein, is evident by this *Experiment*, that when a *Ligature* is made on the *Vas Breve*, the *Vessel* that lies between the *Spleen* and the *Stomach*, that part of it which is betwixt the *Ligature* and the *Stomach* swells, whereas the other part grows flag and empty; which is a plain evidence that some *liquor* is conveyed by the said *Vessel* from the *Stomach* to the *Spleen*, and not from the *Spleen* to the *Stomach*. Moreover, the *Valvulæ* that are in the *Vas Breve venosum*, do oppose the transmission of any liquor from the *Spleen* to the *Stomach*, because all of them lead towards the *Spleen*. Whence it is manifest that something is transmitted from the *Stomach* to the *Spleen*, but not the contrary way.

V. *The Nature of the Liquor that flows out of the Arteries.*

Now this *Liquor* which causeth the *sense* of *Hunger* is *sowre* and *sharp*, as being the off-spring of *Choler* and *Melancholy*, and which therefore lighting on the bottom of the *Stomach*, cannot but twitch and prick the *membrans* whereof it doth consist. Hence it is commonly observed, that *Melancholy Persons* are great *Eaters*, because this *Juice* is more *sowre* in them, than in others, by which means the *Food* is soon consumed thereby, as *Metals* are in *Aqua Fortis*, and other acid *Spirits*, and the *Guts* egg'd on to a ready Evacuation.

VI. *Why some Persons are very seldom sensible of Hunger.*

And on the contrary it sometimes happens, that *persons* who have not eaten of a good while, yet have no *sense* of *Hunger*, nor any desire to *Eat*, as it is frequently so with *Phlegmatick Persons*. Because this *Juice* by some obstruction or other is hindred from entring into the *Stomach*, or because it is too thin and weak, so that the *Stomach* is not sensible of the weak impression it makes upon it; or because its force is blunted by some *cold* and *clammy Humour*, or because there is but little of this *sharp Humour* conveyed to the *Stomach*. For it is always one or other of these causes that occasions the want of *Appetite* to *Food*, and more especially in *Sick People*.

VII. *Of Persons that are troubled with a Dogs hunger, as 'tis called.*

And on the other hand there are some *persons* that are troubled with continual *Hunger*, and who like *Dogs* are ever *Ravenous*, and never satisfied; because so great quantity of this *sharp Humour* is conveyed to their *Stomachs*, that all their *Food* thereby is made *sowre*, so that their *Stomach* is continually twitched, and sollicited to desire more *Food*, the former being readily evacuated downwards, or else cast up by *Vomit*. And thus it comes to pass, that some of this *Humour* is sometimes transmitted to the *Venæ Lacteæ*, and continually besiegeth the *Stomach*.

VIII. *The Irregular Appetite of Women with Child.*

But if this *sharp Humour*, lodging in the bottom of the *Stomach*, be of such a *Temperament*, as to have a peculiar force to dissolve some *Food* sooner than other, then it will be apt to stir up the *Appetite* of one sort of *Meat* rather than another. Hence some *Women* eat *Coals*, *Chalk*, *Quick-lime* and the like. Now the cause of this variety of this *sowre Humour* may be, because in the first *Months* of *Conception*, the Mouth of the *Womb*

being ſtopt, that the *Superfluous Blood* cannot be evacuated as formerly, by this means the *Humours* of the *Body* are corrupted, and being conveyed to the *Stomach*, produce an irregular *Appetite*. And therefore ſome *Phyſicians* are of opinion, that when the *Melancholy Humour* is deprav'd in *Women*, they long for *Quick-lime*, *Coals*, &c. when *ſowre Phlegm* abounds in them they deſire *ſowre things*; and when *Gall* predominates, *Bacon*, *Suet* and ſuch like. And it is from the ſame Cauſe that young *Girls* that are troubled with the *Green-Sickneſs*, as we commonly call it, do take a liking to ſtrange and unnatural ſorts of *Food*, ſuch as *Coals*, *Chalk*, *Leather*, &c. becauſe their *Blood* for want of due evacuations grows ſharper than ordinary, and conſequently the *Humour*, which is derived out of the *Blood* into the *Stomach*, partaking of the ſame Quality, more violently twitches the Nerves thereof, and that after a peculiar manner, according to the various conſtitution of the *Blood* in every Individual.

IX. *It is not Heat that digeſts the meat in our Stomach.* This diſcovers to us the miſtake of the *Peripateticks*, who ſuppoſe the *Stomach* to be like a *Kitchin*, where the *Food* is concocted and digeſted by *heat* only: whereas we find that there is but a moderate *heat* in the *Stomach*, and yet that even *Bones* are conſumed and digeſted in it, as in the *Stomach* of a *Dog*, which if they ſhould be boild for ſome Months together in a Pot with a very ſtrong *Fire*, would never undergo any ſuch change, as we find they do in the *Stomach*. Beſides, *Hiſtorians*, and particularly *P. Breſſano in his Relation of New France*, tell us of moſt ravenous and devouring *Fiſhes*, which do readily digeſt the hardeſt *Bodies* and turn them into *Liquor*, whoſe Stomachs notwithſtanding are ſo cold, that one can ſcarcely endure to touch them; which is an inconteſtable Argument, that the diſſolution of *Food* in the *Stomach* is not to be attributed to *heat*, but to the foreſaid *acid Juice* in the *Stomach*, which diſſolves our *Food*, as ſome *acid Spirits* do *Metals*.

X. *What Thirſt and what Drink is.* *Thirſt is a Deſire of Drink, cauſed by the dryneſs of the Throat and Gullet, or the Heat of the Stomach, commonly called Heart-burning, or a Salt Savour ſticking to the Tongue.* By the name of *Drink* we underſtand every ſort of *liquor*, that is not *Salt*, *Fat* or too *bitter*, for *Salt*, *Fat* and *Bitter Liquours* do rather inflame the *Thirſt* than allay it.

XI. *What is the Cauſe of Thirſt.* To be informed of the Cauſe of *Thirſt*, and that *Dryneſs* which is ſometimes in the *Mouth*, *Tongue* and *Palate*, we are to conſider that the *moiſture* which continually aſcends from the *Stomach* to the *Gullet*, in the form of a thick and moiſt *Vapor*, for the moiſtning of thoſe parts, when at any time it is over agitated or heated, it doth ſo dry the *Swallow*, and at the ſame time ſo affect the *Nerves*, as to excite in the *Soul* the *Appetite* of *Thirſt*. So that there is a greater difference between the *Vapor* which provokes *Thirſt*, and that *Liquor* which produceth *Hunger*, than there is between *Sweat*, and that which exhales from the whole *Body* by inſenſible *Tranſpiration*.

XII. *Thirſt is not an Appetite of ſomething that is cold.* ARISTOTLE was of opinion that *Natural Thirſt* was the *Appetite* or deſire of ſomething that is *moiſt* and *cold*. But this doth not ſeem probable; for tho' *Thirſt* ſeem to be a deſire of ſomething that is *moiſt*, in order to diſſolve, dilute and macerate the *Food* we have taken, and turn it into *Juice*; yet there is no need it ſhould be *cold* rather than *Hot*; foraſmuch as any moiſture doth extinguiſh *Fire* be it *hot* or *cold*. But whether it be more conducing to health to uſe *Cold* or *Hot Drink* is not ſo eaſily determinable, becauſe of the different *Temperaments* of *Bodies*. Only we find by Experience, that the *drinking* of ſome extream *cold liquor* is very hurtful to the *Body*, whereas it is ſeldom known that any hurt accrues to us, by the uſing of *hot drink*.

XIII. *Of the Different Cauſes of Thirſt.* *Thirſt* is cauſed ſeveral ways, as either preſently *after we have eaten*, becauſe of the dryneſs of our *Food*, which like a *Spung*, *drinks* up the moiſture of our *Stomach*; or when our *Throat* is heated by the *effuſion of Gall*, eating of *high ſeaſoned Meats*, &c. or from ſome *Salt Humour* conveyed to that part, whence not only the imagination of *drinking* is awakened, but alſo an inordinate deſire thereof, by which means ſome perſons long for *Vinegar*, *Urin*, *Stinking Water*, &c.

CHAP. XXII.

Of the Common Senſe, Imagination, and Memory.

I. *The Soul is not really diſtinguiſht from its Faculties.* THE Common *Senſe*, *Imagination* and *Memory*, are called the *Inferiour Faculties* of the *Soul*, as being attributed to it, becauſe of its intimate union with the *Body*; whereas the *Underſtanding* and *Will* are ſtiled its *Superiour Faculties*, becauſe they appertain to the *Soul*, ſimply conſidered, and without any reſpect had to its Relation with the *Body*. But as theſe latter are not Beings diſtinct from the *Soul* it ſelf, but only *Modes* of it: So neither are the former any thing elſe but different modifications thereof, ariſing from its intimate union with the *Body*. Thus the Soul, foraſmuch as it perceives all the motions imparted to the *Brain* from the outward *Organs* of the *Senſes*, is called the *Common Senſe*; with reſpect to its long retaining and preſerving the ſame perceptions, it is called *Memory*; and foraſmuch as it variouſly compounds and divides the ſame, it is called *Imagination*. In like manner, with reſpect to its deſiring or having an averſion by reaſon of the *Objects* that are repreſented by thoſe perceptions, it is called the *Senſitive Appetite*; as the *Locomotive* or moving *Faculty* is attributed to it foraſmuch as it commands the *Animal Spirits*, and by their means variouſly moves the *Members* of the *Body* according to its pleaſure. So that theſe *Faculties* are indeed nothing elſe, but outward modifications, or ways of our conſidering the *Soul*, which makes it no more to differ from it ſelf, than *Number* and *Duration* makes thoſe things to differ that are *numbred* or do *endure*; and conſequently the difference there is betwixt the *Soul* and its *Faculties*, is only a Diſtinction of *Reaſon*, that is, a notional diſtinction.

II. *What the Common Senſe is and how the ſame is exerted.* Seeing therefore that our *Bodily Members* are devoid of *Senſe*, and that the *Soul* alone is endued with that Faculty, it remains for us to examin, what inward inſtrument the *Soul* makes uſe of for the perception of *things*, and how the *Species* or repreſentations of *Objects* are conveyed to it. For the motion of the outward *Organ*, is only performed in the *Brain*, becauſe there the *Soul* ex-

exerciseth its *Functions*. Wherefore this *Sense* is called the *Common Sense*, because it receives all the *Species* of the outward *Senses*, and so reacheth their *Objects*. For when we represent to our selves any *Object*, as for Example, a *Man*, we do not only seem to behold the *colour* of his *Face*, and *stature* of his *Body*; but also to smell the *Odours* he is us'd to have about him, to hear him *speak*, to taste the *Food* he eats, and to feel the Softness or Roughness of the *Cloaths* he wears. For from what hath been said already, it cannot be question'd, but that the *Brain* is the *Organ* of the inward *Sense*, forasmuch as the *Nerves* proceed from it, as *Threads* from a Distaff, whereby the *motions* of the outward *Senses* are transmitted.

III. *The* Glandula Pinealis, *or Pine-Apple-like Kernel, is the Seat of the Inward Sense.*

Yet is not the whole *Brain* the Seat of this Inward *Sense*, but only some part of it; for otherwise the *Optick Nerves*, and the *Pith of the Back-bone*, as being of the same Substance with the *Brain*, would be the Residence of the *Inward Sense*. Now this peculiar place of the *Souls Residence*, is the *Conarion*, or *Glandula Pinealis*, a certain *Kernel*, resembling a *Pine-Apple*, placed in the midst of the *Ventricles* of the *Brain*, and surrounded with the *Arteries* of the *Plexus Choroides*. The Reason why we take this *Kernel* to be the peculiar Seat of the *Soul* is, because this part of the *Brain* is *single*, and *one only*. For whereas all the *Organs* of the *Senses* are *double*; there can be no Reason given, why we should not perceive two *Objects* instead of one; but only because both these Impressions are transmitted to a certain part of the *Brain*, which is *single* and *one only*, wherein both are conjoyn'd. Furthermore, it is also requisite that that part should be *moveable*, to the end that the *Soul* by agitating of it immediately, might be able to send the *Animal Spirits* into some certain *Muscles*, rather than into others. And forasmuch as this *Kernel* is only supported by very small *Arteries* that encompass it, it is certain that the least thing will be sufficient to put it into *motion*. And therefore we conclude, that this inmost part of the *Brain* is the *Seat of the Soul*, in which it exerts its operations of *Understanding* and *Willing* of whatsoever proceeds from the *Body*, or tends towards it.

IV. *What the Common Sense is.*

Accordingly *the Common Sense* may be described to be *an Internal Sense, whereby all the Objects of the External Senses are perceived and united in the midst of the Brain, as the common Center of all Impressions.* Or the *Common Sense is* nothing else, but *the concurrence of all motions made by the Objects upon the Nerves, in the Conarion, happening at the same time that the Objects move the Senses.*

V. *The Littleness of this Kernel is no hindrance to its being the Instrument of the Common Sense.*

Neither doth the *Smalness* of this *Kernel* hinder its being the Instrument of the *Common Sense*; but on the contrary, those Persons are the most stupid in whom this *Kernel*, because of its bigness, is not so readily moved; and those the most witty and apprehensive in whom this *Kernel* is less, because it is so much the more easily moved: And tho' it were much less than it is, yet would it be big enough with respect to the several Points of the *Ventricles*, and to the *Pipes* of the *Nerves*.

VI. *What Species and Phantasms are.*

The Foot-steps of *absent Objects*, which are laid up in that simple and pliable *Substance*, by the assistance of the *Nerves*, are called *Species* and *Phantasms*, by *Philosophers*. They preserve the *memory* of *things* before perceived by us, and represent them to us, as oft as we think of them.

VII. *What Imagination is.*

Phantasie or *Imagination*, is nothing else, but a certain application of the Knowing Faculty to the *Body* (*viz.* the *Brain*) which is intimately present to it. Or it *is an Internal Sense, whereby the absent Objects of the External Senses are represented present to the Brain, by reason of the Foot-steps of former Impressions.* For the *Species* of the *Imagination* make us to conceive the *Image* of these things as present to the *Eye* of our *Mind*. For when we do imagine any *Object*, the *Soul* turns it self to the *Body*, there to behold the *Image* or *Representation* which it apprehends, as intimately present to its *Thoughts*.

VIII. *The strength of the Imagination.*

But here ariseth a Difficulty. For if it be so that the *Imagination* be performed in the *Brain*, how comes it to act upon distant *Bodies?* as it happens in some *White-Women* that bring forth *Blacks*, and *Blacks* that bring forth *White Children?* And in those *spots* or *marks* which *Longing-Women* impress upon their *Children*; or that an *Adulterous Woman* brings forth *Children*, that are like her absent *Husband?*

This Difficulty will be easily resolved, if we suppose that the *Imagination* hath not only a great force over the *Brain*, but also over the whole *Body*; for seeing that the *Nerves*, as so many *Strings*, are extended throughout the whole *Body*, they readily convey the *Animal Spirits* from the *Brain* to the *Muscles*, together with the *Affection* impress on the *Brain*. And by the same means the *Imagination* moves the *Humours* of the *Body*, and by this differerent agitation of the *Humours*, the *Blood* becomes alter'd, and consequently the *Skin* and *colour* of the *Hairs* also become changed. Yea, without this change or alteration of the *Blood*, some Impression may be conveyed through the *Arteries* of the *Woman* that is with *Child*, to some certain part of the *Birth* in the *Womb*, and leave a Mark there. See my *Natural History*, concerning *Man*, *Chap.* VI.

IX. *Wherein the Nature of the Memory doth consist.*

Memory is that Faculty of the Soul, which repeats things perceived by former Sensations; or it *is the calling to mind of known and past things.* And differs from the *Imagination* only in this, that from the Foot-steps of former Impressions on the *Brain*, it doth represent as present to it self, *Objects* that were formerly offer'd to it: Whereas *Memory* consists in this, that the *Pores of the Brain*, through which the *Spirits*, determin'd by the *Pine-Apple-like Kernel*, have passed, are thereby become dilated, and consequently more fit to admit the same *Spirits*, repassing that way another time.

X. *Memory is either Intellectual or Animal.*

And accordingly *Memory* is twofold, *viz.* Intellectual and Animal. *Intellectual* is that which belongs to *Angels* and *Souls*, by means whereof they can represent to themselves, the *Thoughts* they formerly have had concerning *Spiritual things*; and this kind of *Memory* doth not stand in need of any *Bodily assistance*. The *Animal Memory* is that which is common to us with *Brutes*, and is performed by means of the *Brain*, and the Foot-steps impress upon it. For Sensual or *Corporeal Memory* imports nothing else, but a certain facility remaining in the *Pores* of the *Ventricles* of the *Brain*, to open themselves again, by reason of their having been

been before opened by the *Animal Spirits*. Or, to ſpeak more clearly, the Foot-ſteps of the *Animal Memory* are thoſe, which the paſſage of the *Animal Spirits* hath left betwixt the *Fibres of the Brain*, through which they have paſſed before, ſo as to go out by the ſaid *Pores* again, as they at firſt enter'd in by them; by which means it comes to paſs, that theſe *Spirits* do more eaſily enter theſe *Pores*, than others; as *Paper* that hath been once folded, is more apt to run into the ſame Folds that hath been formerly made in it.

XI. *How the Foot-ſteps of Memory are formed in the Brain.*

To underſtand how this is done, we are to imagine, that after that the *Spirits* that go forth from the *Glandula Pinealis* H, have left ſome impreſſion of a *Species*, or ſome particular Foot-ſteps of their paſſage, they do paſs from thence through the Points 2, 4, 6, 8, and into the like *Pores* and *Intervals* as are found betwixt the *Filaments*, whereof the portion of the *Brain* E E doth conſiſt. Which *Spirits* have the power of dilating the ſaid *Intervals* in ſome ſort; as likewiſe of folding and diverſly diſpoſing of the *Filaments*, againſt which they puſh in their paſſage, according to their different *motions*, and the various openings of the *Pipes* through which they paſs; that there alſo they may impreſs *Figures* like to thoſe of the *Objects*.

Figure 75.

XII. *How they are tranſmitted to the Brain.*

We are to conceive therefore, that the *Figure* impreſt by the *Object* A B, C D, upon the *Fibres* of the *Optick Nerve*, which it moves or agitates in the Surface of the *Retina* 1, 3, 5, 7, muſt delineate another *Figure* like it ſelf, in the inward Surface of the *Ventricles of the Brain* 2, 4, 6, 8, where the ſaid *Fibres* are terminated: Whence it comes to paſs, that the *Animal Spirits*, which reſide in the *Kernel* H, muſt more ſwiftly paſs out of the *Pores*, that anſwer to them, than they did before; and that too in the ſame form or *figure* of the opening. And thus their Courſe produceth another like to it upon the *Glandula* H, which is that Form to which the *Thoughts* of the *Soul*, which depend on the *Body*, are immediately linked.

XIII. *How theſe Foot-ſteps of the Memory are produced.*

But yet the *Spirits*, which make their way through the Paſſage 2, 4, 6, 8, though they may be of ſome force to dilate the paſſages of the *Fibres* a little; yet they have not power enough at the firſt ſtroak, to impreſs their *figures* upon the *Fibres*, which are in the Subſtance of the *Brain*, with ſo much facility or perfection, but by degrees perform the ſame more acurately, according as the *Action* of the *Spirits* is either ſtronger, more laſting, or more frequently repeated. Whence it follows alſo, that theſe *Figures* are not ſo eaſily obliterated, but do abide there: So that by means of them, *Species*, that at any other time have been impreſt upon this *Kernel*, may a long while after be again repreſented or formed there, even tho' the *Objects* be abſent. And tho' theſe Paſſages ſhould afterwards chance to be ſhut up again, yet they ſtill retain a greater facility or readineſs to be open'd, than other Neighbouring paſſages that were never yet opened. As if many *Needles* ſhould pierce the ſtretched piece of *Linnen* A, the Holes which the ſaid *Needles* had made in it, would remain open, even after that the *Needles* be taken away: Or, if they ſhould be cloſed, yet there would ſome *ſigns* thereof remain in the *Cloth*, which might very eaſily be opened again. And it is to be noted, that if only ſome of theſe *Holes* ſhould be open'd again: As for Example *a*, and *b*, this would be ſufficient to make others of them, ſuch as *c*, and *d*, to be dilated again at the ſame moment of time; eſpecially if all the foreſaid *Holes* had been often open'd, and that all of them had been uſually opened together. Yea, there is a greater facility or readineſs in the *Pores* of the inward *Subſtance* of the *Ventricles* of the *Brain*, of opening themſelves upon the like *Action*, than there can be in the *Linnen Cloth*; for that whilſt the *Spirits* do again open ſome of thoſe Paſſages, the ſaid *Spirits*, becauſe they are diffuſed every way, do in ſome ſort follow the ſame Track (in the ſame manner as we ſee that the *Sound* or *Wind* follows the motion of *Running-Waters*) and by this means do open the Paſſages again that are about them, becauſe of the eaſineſs they find to enter in by them.

Figure 76.

XIV. *How we can remember two Objects at one and the ſame time.*

Moreover, we are to take notice, that in caſe only ſome *Paſſages* were opened, after the ſame manner others would alſo be opened at the ſame time; eſpecially if they had been frequently opened before, and all of them together. Thus when 2 *Objects* have delineated their *Species*, and that the 2 Ranges of the *Spirits*, that have framed them, be ſomewhere joyned in the Subſtance of the *Brain*, it is ſufficent if one of them only be brought to the *Pine-Apple-like Kernel*, for the ſtirring up again of the ſaid *Actions*, which had their riſe from them both. As when we have ſeen the *Noſe* and *Eyes* of any *Face*, we readily apprehend the *Mouth*, *Forehead*, and other parts of it, and imagine them as *preſent* to us, becauſe we are never us'd to ſee any of theſe Parts by it ſelf, but all of them together.

XV. *What ought to be the Temperament of the Inſtrument of Memory.*

From what hath been ſaid, we may eaſily apprehend, that the *Brain* ought not to be over *moiſt* or *ſoft*, that it may the better retain the *Species* impreſt upon it. Thus we ſee that *New born Children*, whoſe *Brain* is in a manner altogether *watry*, cannot retain any impreſſion that is made upon it; and for the ſame Reaſon it is, that tho' *Children* afterwards do with eaſe enough learn things by *Heart*, yet they as eaſily forget them again. Whereas on the contrary, thoſe who have harder and drier *Brains*, do long retain the Marks once impreſt upon them, but cannot without difficulty receive any new *Impreſſions*. Hence it is that *very Old Men*, becauſe of the *Drineſs* of their *Brain*, become wholly deprived of their *Memory*, neither can retain ought of thoſe things that are committed to them; and yet are very retentive of thoſe things they have long ſince committed to their *Memories*; becauſe their *Brain* being grown hard, doth more firmly preſerve the Impreſſions made there.

CHAP. XXIII.

Of Health and Sickneſs.

I. *What Health is.*

Health is nothing elſe, but that *State* of an *Animal*, wherein all its *Powers* can diſcharge their *Functions*, as they ought. Or, it *is a certain diſpoſition of* Body, *and Harmony of its parts, whereby its fitted forth, exerting and performing of all Actions, according to the Laws of Nature.* For as *Harmony* in *Muſick* conſiſts in an agreeable concent of *Sounds*, whilſt every one obſerves

ſerves ſuch a degree of *Depth* and *Height*, that it doth not go beyond, or fall ſhort of a due proportion: So we call that a State of *Health*, when every *Humour* and *Quality* obſerves that exact degree of *Intention* and *Remiſſion* that they never exceed in, or fall ſhort of a congruous proportion. Hence GALEN in his *firſt Book of the preſervation of Health*, defines *Health* to be ſuch a conſtitution of *Body*, in which we are neither ſenſible of any Pain, neither are we hindred in any of the functions of *Life*: And that therefore thoſe *Men* are to be accounted *Healthful*, who without any pain or impediment can perform all the neceſſary *functions* of *Life*.

II. *Two things are requiſit to health* There are 2 things more eſpecially that concur to the conſtituting of *Health*, viz. *a due Temperament of the Humours, and compoſition of the parts*. By the name of *Temperament* we underſtand a certain *mixture* or *Union*, according to which the *Natural Functions* are well and duly performed. And conſequently the diſtemperature of the *Humours*, as the Exceſs of *Choler*, *Phlegm* or *Melancholy* do ſpoil *Health*, and hinder the uſe of our Natural *Faculties*. A congruous conſtitution or compoſition of the *Parts*, conſiſts in a due *Number*, *Magnitude*, *Situation*, *Figure* and *Connexion* of the ſeveral *Parts* and *Organs*, and ſuch a diſpoſition of the *Fibres*, as the Natural *Faculties* ſtand in need of to diſcharge their ſeveral *Functions*.

III. *There is a Two-fold Health according to Phyſicians.* *Phyſicians* commonly diſtinguiſh *Health* into that which is *Beſt* and *Abſolute*, which conſiſts in a manner in an indiviſible point, from which, if there be never ſo ſmall a varying or deviation, the ſame is eſteemed to be a *Sickneſs* or *Diſeaſe*; and the *Other* which is alſo *perfect*, tho' probably it may admit of ſome exceſs or defect, but not ſo great, as that it can be accounted for a *Sickneſs*, tho' it may cauſe ſome little hinderance in the natural *functions*, or cauſe ſome inconſiderable *Pain*. The *former* of theſe States of *Health* is not to be found in *Nature*, and can only be conceived in our *Minds*: Tho', as GALEN ſaith, it may ſerve for a *Rule*, by which we may meaſure or compute the greater or leſs degrees of *Health*. The *Latter* is attributed to every *Man*, and is not found in a lower degree except it be accidentally. For *Nature* always affects that which is beſt; and if at any time it cannot effect what it intends, yet it always performs the beſt it can.

IV. *What things conduce to the preſervation of Health* Many things are conducive to the preſerving of the *Health*. *Firſt* the AIR, which being taken in by the *Mouth* and *Noſtrils*, enters the *Body*, and is neceſſary to rid the *Blood* of *fuliginous ſteams* by means of the *Lungs*; which ſhould it not be continually done, as well the Branches of the *Venal Artery* as of the *Arterial Vein* would be obſtructed, and not only *Health*, but alſo our *Life* would be in danger.

Secondly, Care is to be taken about our FOOD; for ſeeing that we ſtand in need of *Food* to repair and reſtore the *Conſumption* made by our Inward *Heat*, we are to mind that it be taken in ſuch *Quantity*, *Manner*, *Time* and *Place* as may be moſt conducive to the *Health* of our *Bodies*. For neither muſt it be taken in ſo *ſmall* a *Quantity*, as to famiſh or weaken our *Bodies*; nor ſo *copiouſly*, as thereby to overcharge our *Stomachs*; nor ſo *frequently* as to diſturb the Digeſtion of the *Food* we have laſt taken; nor ſo *ſeldom* as to defraud our *Stomachs* of their due allowance.

Thirdly, The Retention and Voiding, or Excretion of our ALIMENTS; for ſeeing that the pureſt and beſt of the *Food* muſt be changed into the *Subſtance* of the *Body* that is fed, it is of abſolute neceſſity that it be retained in the *Body*: And ſince it cannot be ſo pure, but that it muſt contain ſome *Heterogeneous Parts*, the ſame muſt be voided, leſt by overlong ſtay in the *Body* it ſhould putrifie, and diſturb the *Oeconomy* thereof.

Fourthly, Moderate EXERCISE; for *motion* is a great help to excite *Heat*, and to open thoſe *obſtructions*, which hinder corporal *Functions*. But yet on the other hand, overviolent and unſeaſonable *Exerciſe*, waſtes the *Body*, and by diſturbing the inward *Oeconomy*, frequently is the cauſe of *Diſeaſes*.

Fifthly, REST; for ſeeing that as long as we are *awake*, the *Spirits* continually courſe it through the *Organs* of our *Body*, this cauſeth *Wearineſs*, which muſt be reſtored by *Reſt* and *Sleep*. Wherefore whenever we *watch* too long, our *Spirits* become diſſipated, the ſtrength of our *Body* weakned, our concoction is hindred, and our whole *Body*, and more eſpecially our *Brain*, is thereby dried.

Sixthly, moderate PASSIONS and AFFECTIONS, eſpecially thoſe of *Joy* and *Cheerfulneſs*, which promote and help the motion of our *Spirits*, and cheriſh and recreate all congruous functions. But of all things, nothing is more conducive to *Health*, than for every *Man* to take heed to himſelf, and carefully examin what he finds *Good* or *Hurtful* to him, endeavouring always to avoid the one, and procure the other, and to uſe it in due time and manner. And accordingly CICERO tells us in the *4th. Book of his Offices*, *Health* is maintained by the knowledge of ones own *Body*, and by making obſervation of thoſe things, which are wont to be *Good* or *Hurtful* for us, as alſo by continual *Temperance* and Continence throughout the whole courſe of our *Lives*, together with the care to keep our *Bodies* neat and cleanly.

V. *What Sickneſs is, and that it only reſides in the Body* SICKNESS on the contrary is ſuch a *ſtate* of the parts of our *Body*, whereby they are hindred from the due performance of their *Functions*. And therefore whatſoever overthrows the *Temperament* of the foreſaid *Humours*, or the compoſition of the *Parts*, is called *Sickneſs*. Tho' *Sickneſs* doth attack the whole *Man*, yet doth it only conſiſt in the *Body*; becauſe thoſe Diſtempers which ſeem to affect the *Soul*, are only ſome conſequences of *Bodily Sickneſs*; as appears manifeſtly in that as ſoon as the *Body* is cured, the *griefs* and uneaſineſs that were found in the *Soul* do immediately ceaſe, and no longer afflict it.

VI. *Of the two General Heads of Sickneſs.* *Sickneſs* is commonly divided into two General *Heads*, *viz.* into *Sickneſs* of the *Similar* and *Diſſimilar Parts*. *Sickneſs* of the *Similar Parts*, is called a *Diſtemper*, when it is ſuch as that it ſenſibly hurts our *bodily Actions*, as when any *Quality*, by Example, that of *Heat* or *Cold* doth exceed. And this *Diſtemperature* is either *Manifeſt* or *Hidden*. *Manifeſt* is that wherein the *Qualities* that exceed are known. *Hidden*, when

by reaſon of the ignorance of the exorbitant *Qualities*, the cauſe of the *Diſtemperature* cannot be found out.

VII. *Diſeaſes of the Diſſimular or Organical Parts.* The other kind or General Head of *Diſeaſes* is of the *Organical Parts*, which are ſaid to be *vicious* or faulty, with reſpect to their *Conformation*; or with reſpect to their *Magnitude*, when they are either greater or leſs than they ought to be; or with regard to their *Number*, when therein they exceed, or are defective; or as to their *ſituation*, when they are not rightly placed; or as to their *Figure*, when it is not ſuch as it ought to be; or with reſpect to their *Connexion*, when they are at too great diſtance from each other, or if they be overmuch crowded together, ſtretched, compreſt, looſened, or grown too ſtiff.

VIII. *Some Diſeaſes afflict only ſome parts, others the whole Body.* There is alſo another Diviſion of *Diſeaſes* into Univerſal and Particular: *Univeral* Diſeaſes are ſuch as afflict the whole *Body*, as *Agues* and *Fevers*. Others *Particular*, which only affect one part of the *Body*, as the *Brain*, *Lungs*, *Throat*. But to theend that we may be able to underſtand the chief *Diſeaſes* of the *Body*; we ſhall conſider them in the following Order.

IX. *Pain of the Head, or Headach.* The Firſt *Diſeaſe*, and which hath its ſeat in the *Membrans* of the *Head*, is the HEADACH, *which is a Pain, or troubleſom Senſation of the Head, proceeding from the Exorbitant Figures of the Blood, which ſpoil the Temperament thereof.* For when the *Animal Spirits*, being too violently agitated by reaſon of a too *Cholerick* and Glewy *Arterial Dew*, are driven through the *Arteries*, to the *Head*, and the *Filaments* and *Membrans* of the *Brain*, they forthwith diſorderly twitch, corrode, prick and cut the ſame, and finding the *pores* through which they would make their way, not correſponding with them in *Greatneſs* and *Figure*, they by their force ſlit them up, and thereby produce an exquiſit pain in the *Head*. Hence in the cure of this Diſeaſe there is made uſe of *Blood-letting*, and other things conducing to the changing of the *Diſtemper* of the *Blood*, and to drive away the *ſharp particles*, which are got into the moſt ſenſible *Membrans* of the *Brain*. *Purging Medicines* are alſo uſed, whereof ſome are more proper to expel theſe, and others, other *particles*; ſuch as are *Aqueous* and *Oleous Medicaments*, which alſo ſtop the too ſwift motion of the *Animal Spirits* in the *Blood*.

X. *Phrenſie.* PHRENSY or Raving *is a violent agitation of the Brain and Membrans thereof, cauſed by the exceſſive heat of the Blood, and its being filled with ſharp and other malignant particles, which entring the Pores and Membrans of the Brain, do frequently cauſe an Inflammation there.* Which then happens when *Triangular Particles* light upon Round *Pores*, whereupon in every ſuch *Pore*, there are left three little ſpaces, becauſe of the threefold ſurface, for the filling up of which ſpaces, the *ſubtil matter* preſſeth in with more abundance, by the ruſhing in whereof the *Parts* and *Humours* become agitated and diſturbed. Whereupon the *Glandula Pinealis* is no longer in a condition to diſcharge its *function*, becauſe theſe *Animal Spirits* are no longer ſubject to any *Rule*, but as *Refractory Souldiers* and Deſerters, caſt off the Yoke, and courſe it up and down without *Rule* or *Diſcipline*. Wherefore *Opiates* are commended for the cure of this *Diſeaſe*, which both reduce the *Raging Spirits* to reſt and compoſure, by cloſing up the *Nerves*, as it were, with *Bird-lime*, and ſtop the irregular motion of the *ſharp particles*, which before did cut the *Fibres*, and little *Branches* of the *Nerves*, that thoſe *Fibres*, which before were ſtretched out like *Cords*, do run together into twiſted Knots and *Bunches*, which *Knots* ſtop the paſſage of the *Spirits* through the *Nerves*, and ſo hinders them from being tranſmitted to all the *parts* of the *Body*, and conſequently from diſcharging the wonted *functions*. *Refrigerating* or *Cooling Medicaments* are likewiſe of uſe in this diſtemper; as for Example, the *Chymical Preparation* called *Nitrum Perlatum*, which being diſſolved in *Water*, is found to be of very good uſe in this caſe, becauſe it fixeth the *Spirits* and the *Blood*, and at the ſame time opens Obſtructions; as alſo *Diſtill'd Vinegar*, *Antimony Diaphoretick*, and Powder of *Pearl*, *Coral*, &c.

XI. *Melancholy.* MELANCHOLY which is commonly defined to be *a Doating, without a Fever or Raving; is a Delirium* or Doating, *proceeding from the ſadneſs of the Patient, whereby the Animal Spirits are moved more ſlowly than they are wont.* This diſtemper of the *Blood*, is commonly the product of a vicious *Sowre Humour* in the *Blood*, by means whereof the *Animal Spirits* are darkned and condenſed, which roving through the former footſteps left in the *Brain*, and rebounding from them, repreſent the ſame *Images* to the *Soul*; and accordingly *Melancholy Perſons* think the things they have once conceived to be always preſent with them. Wherefore *Alterating Remedies* are much uſed in this *Diſeaſe*, and particularly ſuch as abound with much *Volatil Salt*, as all *Spirituous Matters* do, as by Example, the *Juice of Betony*, *Scurvygraſs*, *Brooklime*, *Chickweed* and ſuch like, by means whereof the *Ropy* and viſcous diſtemperature of the *Blood* is amended.

XII. *Madneſs.* MADNESS *is another kind of Doating, accompanied with great Rage and Alienation of Mind, without a Fever, proceeding from the irregular motion of the Animal Spirits being inflamed, and turned into a fiery Nature.* For the *Spirits* being excited by ſome outward cauſe, and inflamed, range about through the *Brain*, but more eſpecially about the *Glandula Pinealis*, and ruſhing like *Lightning* into the *Brain* and *Muſcles*, do put the *Glandula* out of the *Souls* command, which being deluded by theſe *Spirits*, and deprived of all her command over the *Body*, can no longer guide or govern it; whence proceed ſo many undecent *Geſtures*, *Fightings*, *Quarrels*, *Bawlings*, &c. In order to the ſtopping of this Efferveſcence of the *Blood*, ponderous *Remedies* are made uſe of, as *Lapis Prunellæ*, *Saccharum Saturni*, or *Sugar* of *Lead*, *Crabs Eyes*, *Laudanum Opiatum*, *Sanguis Draconis*, &c. *Decoctions* alſo made of ſome ponderous ſorts of *Wood*, are profitable in this caſe, as which by their heavy and hard *Particles*, do ſtop the motion of the *Blood*.

XIII. *Lethargy.* LETHARGY *is an irreſiſtible inclination to Sleep, accompanied with great forgetfulneſs, cauſed by an Obſtruction of the Pores of the Brain, by a thick and groſs Humour, and the want of Animal Spirits.* This *Diſeaſe* is alſo in a great meaſure cauſed by *Steams* and *Vapours* that are mingled with a *Slimy*, *Ropy Due*, which being condenſed into *Water* overwhelm the *Brain*, and

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the *Soul* together with it. And accordingly this *Diſeaſe* is cured by *Volatil* and *Aromatical Remedies* which reſtore the *Spirits*, and by their volatility open the *Pores*, and cut the *Viſcid* or *Slimy Matter:* Such as are all *Spirituous Matters*, all *Volatil Salts*, eſpecially ſuch as are *Aromatical* and *Oleous*, alſo the *Wood Guajacum* and *Saſſafras*, the *Roots of Maſterwort*, the Herbs, *Balm*, *Betony*, *Organy*, *Sage*, *Marjoram*, *Thyme*, *Roſemary*, &c.

XIV. Coma Vigil, *or the Waking Drowſie Diſeaſe.* COMA VIGIL or the *Waking Drowſineſs*, is *a Diſtemper accompanied with a ſtrong Inclination to Sleep, wherein the Patient lies drowſing with his Eyes ſhut, without being able to fall aſleep.* This *Diſeaſe* is cauſed by too great a dilatation of the *Pores* of the *Brain*, from the too much inflamed and agitated *Animal Spirits*. Wherefore in this *Sickneſs* it is neceſſary to purge the inflamed *Choler*, which puts the *Blood* into a violent *Fermentation*; and to correct the ſaid *Humour* by *Acids*. For the beſt way to cure this *Diſeaſe* is by ſuch *Remedies* as do allay and aſſwage the ſharpneſs of the *Humour*, and *Cordials* that reſtore ſtrength, as alſo by *Sudorificks*, which volatilizing thoſe ſharp *particles*, drive them by ſweat out of the *Body*.

XV. Catalepſis. CATALEPSIS *is a ſuddain Detention or Immobility of the Body, accompanied with a weakning of the Senſes, whereby the Patient retains the ſame figure of the parts of his Body, which he had in the firſt moment when he was ſeized with this Diſtemper.* This Dreadful *Diſeaſe* is not cauſed by a freezing of the *Animal Spirits*, and the *Humours* that are in the *Body*, or from a *Vapour* that congeals the *Spirits*, as the *Galaniſts* do ſuppoſe, ſeeing that no ſuch thing can happen to the *Spirits*, but becauſe the *Animal Spirits* are no more ſubject to the command and guidance of the *Soul*, by reaſon of the Obſtruction of the *Glandula Pinealis*, and therefore cannot move the parts as they uſed to do. So that the Cauſe of this Diſtemper is no other, but the Obſtruction of either ſide of this *Kernel*. Wherefore for the taking away of this Obſtruction, and to reſtore the *Animal Spirits* to their Due and Regular Motion, *Volatil Salts* are preſcribed, and *Cephalicks*, or Medicaments appropriated to ſtrengthen the *Brain*, and the *Glandula Pinealis* in particular, the proper ſeat of the *Soul*. Strong Motions and Frictions, or *Rubbings* of the *Body* are commended with hot and courſe *Linnen Cloath*.

XVI. *The* Vertigo. The VERTIGO *is a Sickneſs wherein all Objects about us ſeem to turn round, cauſed by the undue circular motion of the Animal Spirits.* Becauſe in this Diſtemper the Humours and *Blood* are ſo toſſed and agitated, that by their irregular motion they affect the Roots of the *Nerves*, and preſſing and crowding upon one another, make it appear as if all *Viſible Bodies* turned round. Which crowding and compreſſion proceeds frequently from the Depravation, and ſometimes from the Abundance of *Blood*. And conſequently the cure of this Diſeaſe is commonly undertaken by *Spirituous Medicines* that remove Obſtructions, by *Cephalick* and *Aromatical Balſams*. But if this *Diſeaſe* be cauſed by an over-great *abundance of Blood*, then the *breathing of a Vein* is neceſſary; if from ſome depraved *Juice* lurking in the *Stomach*, *Vomits* are moſt proper, as alſo *Marmelad of Quinces*, *Biſket* and *Cruſts* of *Bread* to correct the ſaid vitiated *ſharp Humours*.

XVII. *The* Epilepſy, *or Falling Sickneſs.* EPILEPSY or the *Falling Sickneſs, is a convulſive motion of all the Parts of the Body, more eſpecially of the Hands and Feet, accompanied with a deprivation of the Inward and Outward Senſes.* This *Diſeaſe* proceeds from a Depravation of the *Blood*, and an Obſtruction in the *Solid Parts*, cauſed by *ſquare figured Particles*, which afflict the *Nerves* with their *Angles*, which way ſoever they apply to them; as alſo by *hooked particles*, which being once faſtned in the *Fibres* of the *Nerves*, cannot ſo readily be diſintangled thence. For the ſmoothing, and infolding of which *particles*, the *Decoctions of ſeveral ſorts of Wood*, and other *Cephalicks* are made uſe of; whereby the ſharpneſs of the *Humours* is blunted, and the points of the *particles* ſmoothed, as may be ſeen in a *Knife*, *Sword*, *Needle*, &c.

XVIII. *Apoplexy.* APOPLEXY *is a ſuddain ceaſing of all Animal Actions*, viz. *Senſe and Motion, with the Hurt of the Principal Faculties, proceeding from an over-great Dilatation and opening of the Pores of the Brain, and the Plexus Choroides.* For by this means is often cauſed a total Obſtruction of the *Brain*, which is the Beginning or Riſe of the *Nerves*, by a foreign Humour flowing into the *Brain*, which ſtops up the way for the *Animal Spirits*, whereupon all the *Members* of the *Body* flag, and become immoveable; as *Sails* fall flat, and hang limber, when the Wind fails, that before diſtended them. According to this notion of this *Diſeaſe*, liberal *Blood-letting* is very conducive in that *Apoplexy*, which is cauſed by too great abundance of *Blood*; and a more moderate *Blood-letting* in that which proceeds from abundance of *Phlegm*. *Rubbing* of the parts with *Hot Cloaths* are alſo commended, and with *Spirituous Liquors*; for by theſe the *Animal Spirits* are excited, and the clogging matter that obſtructs the *Nerves* is by this means the better removed. *Gentle Gliſters* are alſo of good uſe in the beginning of this *Diſtemper*, and afterwards ſuch as are more ſtrong and vehement.

XIX. *The Palſie.* The PALSIE *is a Privation of Senſe and Motion*, either throughout the whole *Body*, which is leſs frequent, or in ſome *Members only proceeding from the want or weakneſs of the Animal Spirits*. For where the *Spirits* are either altogether wanting, or not in ſufficient Quantity, the *Nerves* and *Muſcles* become limber and flaggy, by which means *Senſe* and *Motion*, either altogether ceaſe, or are remarkably weakned. Wherefore in order to the Cure of this Diſtemper *Phyſicians* take away a little *Blood*, to free the Paſſages from Obſtructions, and afterwards exhibit *Medicaments* proper to correct the thickneſs and clammineſs of the *Blood*, and to make it more thin and fluid; ſuch as are *altering* and *inciding Cephalicks* and *Aromaticks* appropriated to the *Brain* and *Nerves*. This done, the Pores of the *Brain*, and *Pipes* of the *Nerves* may be opened by *Sudorificks*, eſpecially ſuch as conſiſt of hard and ſtiff parts; *viz. Saſſafras*, *Guajacum*, *Sarſaparilla*, &c. to the decoctions whereof ſome *Salt* of *Tartar* may be added, for to make the extraction the ſtronger by opening of the *Pores* of the ſaid *Woods*.

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XX. *Convulſion.* CONVULSION, commonly call'd the *Cramp*, *is an involuntary, continual and painful Contraction of the Muſcles, proceeding from a tough, cold and thick Windy Vapour, puffing up and diſtending the Parts.* To the removing of this *Diſtemper*, are made uſe of all *Medicaments* that open *Obſtructions* and break *Wind*, whether inward or outward, *Volatile Salts*, and all *Cephalicks*.

XXI. *The Night-Mare.* The *NIGHT-MARE*, *is a great diminution of the Animal motion, and of thoſe parts that are ſerviceable to the forming of the Voice and Reſpiration, and more eſpecially the Nerves called* Phrenici *and* Recurrentes, *proceeding from the want of the Influx of Spirits, with the falſe Imagination of an Heavy weight lying upon one, in the appearance of ſome frightful Spectre.* For whenever during *Sleep*, the *Spirits* do not flow freely into the *Muſcles*, then ſuch a Motion is produc'd, as whereby the *Soul* judgeth ſome great Burthen to lye upon it, which hinders the free motion of the *Midriff*. Now this ſenſe of being *ſtrangled* or choak'd is occaſion'd, by reaſon of the *Spirits* being hindred from their free ingreſs into the *Muſcles* of the *Throat*, which thereupon flag and fall down, and ſo produce this Senſe of *Strangulation*. In this Diſeaſe, the uſe of *Volatile Salts* is much commended, eſpecially joyned with *Spirituous means*; and ſo likewiſe *Aromaticks*, and other *Medicaments*, proper to incide and attenuate, and conſequently to open the Obſtructions of the *Pores* of the *Midriff*.

XXII. *A Catarrh, or Rheum.* A *CATARRH* or Rheum *is an Effuſion of the ſharp particles of the Blood, or ſerous part of it, in every part of the Body, being becauſe of its long ſtay there coagulated, and producing a pain in the Part either with, or without a ſwelling.* For when the due and regular mixture and conſiſtence of the *Blood* is ſpoiled by Scrous and *Pituitous matter*, many *ſharp particles* are caſt out into the *Glandulous parts*, which by their acrimony, and other manifold malignity twitch the *Membrans*, whereupon follow frequent *Sneezing*, troubleſome *Coughing* and *Hoarſneſs*. In the beginning of this diſtemper, *mild Catharticks* are much commended, as *Pilulæ de Succino* and other *Aloeticks*; *Bliſters* alſo, and *Iſſues*, and *Scarifications* are commended in order to the *Evacuation* of the *ſerous peccant Humour*. Moreover all *Oleous* and *Fat things* are of good uſe in this caſe, becauſe that by the ſoftneſs of their parts, they do infold and blunt the ſharp points of *Heterogeneous ſaline particles* in the *Blood*; as likewiſe thick and *Earthly Medicaments* as *Crabs Eyes*, *Terra Sigillata*, *common Bole*, *&c.* becauſe theſe are proper to file and rub off the ſharp corners of *Salts*.

XXIII. *Cough.* Having thus handled the *Diſeaſes* and *Diſtempers* of the *Head*, we next proceed to conſider thoſe of the *Breaſt* or *Cheſt*, and here we ſhall in the firſt place Treat of that Diſtemper commonly called a *Cough*, *which is a more frequent, uneven and Loud expiration or out-breathing, whereby a great part of Spirits burſting forth violently, endeavour to caſt forth ſome ſharp, and troubleſome Excrements, cauſed by the ſharp, and pricking particles of the Blood, which by the Circulation of the Humours, are carried into the Muſcles deſign'd for inſpiration or expiration*, and being there in greater quantity than ordinary, do painfully *twitch* the *Parts*, and ſtir up a *Convulſive motion*. For the *ſharp particles* like ſo many *Knives* or *Prickles*, being entred into the ſubſtance of the *Lungs* and the *Fibres* of the *Branches* of the *Windpipe*, do neceſſarily produce a kind of Convulſion, *viz. a Cough*. Wherefore, in order to the blunting of theſe ſharp pointed *Particles ſweet* things are commended, and *Opiats*, which do alſo allay the ſharpneſs of the *Humour*. *Vinegar of Squills* is alſo of good uſe, eſpecially where the Patient is troubled with *tough Phlegm*. And for a Purge *Mercurius Dulcis* is commended, becauſe it doth cut *Phlegm* and evacuate it.

XXIV. *The Tiſſick.* *ASTHMA*, or *Tiſſick*, *is a difficult and thick fetching of ones Breath*, with, or without a *Fever*, ſometimes with great wheezing, and other times without it, *proceeding from an ill affection of the ſubſtance of the Lungs, and the Intercoſtal Muſcles, ſerving to Reſpiration.* For whenever the *Nerves*, that belong to the *Intercoſtal Muſcles*, and other *Organs* ſerving to *Reſpiration*, are obſtructed, it produceth difficult *Breathing*. For the removing of which Obſtructions, *Phyſicians* commend the uſe of mild *Aromaticks*, and *Volatile*, *Oleous Salts*, which by their Volatility are very proper to pierce the windings of the *Lungs*, and to open their Obſtructions, cauſed by tough and *ſlimy matter*. The fore-mention'd *Decoctions* of *Wood* are likewiſe very uſeful, as conſiſting of hard, ponderous and ſtiff *Particles*, which by their irregular *figure* and *heavineſs* drive through the *Pores*, reſolve the viſcid or tough *matter*, and reſtore the *Blood* to its due fluidity.

XXV. *The Pleuriſie and Peripneumonia.* The *PLEURISIE*, as alſo the *PERIPNEUMONIA*, *is an Inflammation, the one of the Pleura*, (that is, the *Skin* that covers the *Ribs*;) *the other of the Lungs, accompanied with the greateſt difficulty of* Breathing, *a high Fever, a continual Cough, ſometimes with Frothy Spittle, and frequently alſo with that which is* Bloody, *with great Pain, Heavineſs and Anxiety about the* Breaſt *and Heart, cauſed by a ſharp, diſtending, pricking and corroding Matter.* For this *Matter* is nothing elſe in the *Pleuriſie*, but the ſharp-pointed and volatile Parts of the *Blood*, tranſmitted to the *Membrans* that cover the *Ribs* and the intercoſtal *Muſcles*; whereas in the *Peripneumonia*, or *Inflammation* of the *Lungs*, they are conveyed into the very Subſtance of the *Lungs*, and extravaſated thence. Wherefore in either of theſe Diſtempers, it is proper to *breath a Vein*, as well to allay the furious efferveſcence of the *Blood*, cauſed by the foreſaid *Particles*, as to evacuate ſome part of them. And to alter and correct the ſharpneſs of the *Particles* of the *Blood*, teſtaceous *Powders* are commended, which do not only imbibe the acidity of the *Blood*, but alſo by their ponderoſity, ſerve to diſſolve the *grumous* and coagulated parts thereof.

XXVI. *The Conſumption of the Lungs.* *PHTHISIS*, or the *Conſumption of the Lungs*, *is a waſting of the whole Body, with a ſlow or Hectick Fever, and Cough, with the ſpitting of Purulent matter, cauſed by the ſharp Particles of the Blood, fretting and corroding the Lungs.* For theſe malignant *Particles*, whether proceeding from the *Arteries*, or the *Lymphatick Veſſels*, or from the open'd Impoſthume of a *Quinſie* or *Pleuriſie*, by effuſion of the Purulent matter into the Cavity of the *Breaſt*, do there infect and taint the *Lungs*. And therefore to rid the *Lungs* of theſe

these sharp and corroding *Particles* of the Purulent matter, *Physicians* prescribe hard and ponderous *Remedies*, *viz. Testaceous Powders*, and the *Decoctions* of several sorts of *Wood*, which have a virtue to imbibe and alter the sharpness of the *Humour*: *Mercurius Dulcis*, *Bole-Armenick*, and *Terra Sigillata*, are also commended in this Distemper.

XXVII. *Syncope or Swounding.*

SYNCOPE, or *Swounding*, *is a sudden failing of the strength of the Body, caused by the Extinction for a time, or overwhelming of the vital Flame in the Heart.* For the want of a sufficient store of *Spirits*, with the ceasing of the *Circulation* of *Humours*, and of the determination of the *Spirits* into the *Muscles* for that time, makes the *Body* fall down like the *Trunk* of a *Tree*. In this *Disease* are commended *Spirituous Medicaments*, and *Volatile Salts*, which are proper to kindle and feed the flame in the *Heart*; as all *spirituous*, *cordial*, *odoriferous Waters*, such as *Cinamon-water*, *Aqua-mirabilis*, *Vita-Matthioli*, and the like, which rowze, corroborate and multiply the *Spirits*.

XXVIII. *Cardialgia or Pain at the Heart.*

The Diseases of the *Abdomen*, or *lower Belly*, are *CARDIALGIA*, the *Pain at the Heart*, which *is a painful Sensation at the Mouth of the Stomach, which by means of the Nerves is presented to the Soul.* This *Pain* proceeds from the sharp and pointed *Particles*, that do prick, twitch and slash the *Nerves* and their *Fibres*, and consequently shake them; which Agitation being convey'd to the *Organ* of the *Common Sense*, it is vehemently moved thereby, and so represents to the *Soul* that afflicting Sensation, which we call *Pain*. Accordingly for the Cure of this Distemper, are prescribed several *Remedies* proper in *Convulsions*, but joyned with *Specifick Stomachicks* and *Opiates*, to which are frequently added the Powder of *Native Cinnabar*, *Amber*, *Man's Skull*, *&c.*

XXIX. *Singultus or the Hickock.*

The *HICKOCK* is a *Convulsive motion of the Midriff, caused by tough and irregular Particles, twitching and forcing it to this disordinate motion.* For the *Fibres* of the *Nerves* of the sixth *Conjugation*, distributed to the *Stomach* and the *Midriff*, are so vellicated in this Distemper, that by their motion communicated to the *Brain*, they frequently open those *Pores* there, by which the *Animal Spirits*, rushing violently towards the Mouth of the *Stomach*, contract the *Fibres* appointed for the expulsion of any offending *matter*, upwards, and make the *Patients* to explode the *Air*, contained in the *Mouth* of the *Stomach* with that vehemence, as constitutes the *Hickock*; which ceaseth as soon as the sharp twtiching matter is discharged by these repeated Convulsion *Motions*. For the correcting of these peccant *particles* all hard and ponderous *matters*, are commended, as *Crabs Eyes*, *Coral*, *Filings of Steel*, *Mercurious Dulcis* and *Opiates*.

XXX. *Diarrhœa a Scouring or Lask.*

A LASK *is the dejection of various and liquid Humours by stool, caused by the effervescence of the Blood, encreased by the cholerick particles thereof, and irritating the Fibres of the Guts by their sharp points.* For various *Humours* being precipitated through the *Vessels* which open themselves into the *Guts*, do vellicate their *Fibres*, and by this means make the *Animal Spirits* to rush down that way in greater abundance, whereupon a kind of Convulsion follows. In the dry *Gripes* and the *Lienteria*, or that *Scouring*, when the Meat passeth away in the same manner as it was taken in, the ferment of the *Stomach* is faulty, as not duly digesting the Food put into it. In all Lasks or Scourings, at the beginning *Rhubarb*, *Jalap*, and *Crabs Eyes* are commended, mixed with other proper *Medicaments*; and in the *Lienteria* and dry *Gripes*, *Balsamick Remedies* and *Stomachicks*, are given both inwardly and outwardly.

XXXI. *Cholera or the Cholerick Passion.*

The *CHOLERICK Passion is a depraved Convulsive motion of the Stomach and Guts, occasioned by sharp and pointed particles twitching the Fibres of the Stomach and the Gut called Duodenum, and contracting them upwards.* For this twitching of the *Fibres* cannot continue long, without irritating of the *Animal Spirits*, and disturbing of them in their several *Orders* and *Stations*, and thereby causing them to produce these Convulsive *motions*. In order to the quelling of this fury of the disturbed *Animal Spirits*, *Bezoardicks* are commonly prescribed, and all ponderous Medicines, as *Crystal*, *Terra Sigillata*, *&c.*

XXXII. *Dysenteria or the Bloody Flux.*

The *BLOODY FLUX is an Exulceration of the Guts, accompanied with frequent and Bloody Dejections, and violent Pain and Gripings, caused by sharp particles that corrode and cut the small Fibres of the Guts.* For the Hooked and Pointed *Particles* that are mixed with the *Humours*, do pierce and divide the Membrans of the *Guts*, and by this means cause an Ulcer therein. In order to the cure of this Disease, *altering* and *Evacuating Medicines* are made use of: and above all *Rhubarb*, because it leaves an adstringent Virtue behind it after Evacuation. *Emollient* and *Lenitive Medicaments* are likewise employed for the removing of this Distemper, and such things as promote Fermentation, as *Coral*, *&c.*

XXXIII. *Iliaca Passio or the twisting of the Guts.*

The *TWISTING of the GUTS*, *is a most exquisit Pain of the small Guts, accompanied with a most obstinate stoppage of the passage downwards, and vomiting of the Excrements, proceeding either from an Inflammation of the Guts, or from their obstruction by some hard Excrements.* This *Disease* is often caused by *sharp Humours*, sticking within the *Membrans* of the *Guts*, which cause the Expulsory motion of the *Guts* to be turned the contrary way, because of the irritated *Animal Spirits*, flowing from the *Brain* into the ascending *Fibres* of the *Guts*, which influx being perverted, the *Excrements* contained in them are voided upwards by the *Mouth*. In the cure of this dreadful and desperate *Disease*, *Blood* letting is made use of, to remove the *Inflammation*; and afterwards *Emollient* and *Lenitive Glisters* to evacuate and temper the *sharp Humours*, and to make the passages glib and slippery. For the same purpose *Lenitive Catharticks* are commended. *Crude Mercury* is also prescribed mixed with the *Yolk* of an *Egg*, that it may not stick to the *Guts*; and lastly *Narcoticks*, which both correct the *sharpness* of the *Humours*, and allay the *Convulsions* of the *Guts*.

XXXIV. *The Colick.*

The COLICK *is an afflicting and painful sensation in the Colon, or its neighbouring Parts, caused by a Cholerick Humour joyned with a corroding Salt.* For there is a sharp *Salt* contained, not only within the Hollow of the *Guts*, but also betwixt the *Membrans* of them; which *saline*

particles, when they enter into such *Pores*, through which they cannot pass, they become, as it were, lock'd up there, that is, in the *pores* of the *Coats* or *Membrans* of the *Guts*, where they occasion a most acute Pain, by twitching and corroding the *Fibres* thereof. Wherefore to break the force of this *sharp Humour*, and to heal the hurt *Fibres* of the *Nerves*, several Asswaging and Anodynous *Medicaments* are prescribed, and sometimes *Opiates*, to give some respit to the *Patient*, and that the *Physician* may gain time to eliminate that foreign and præternatural *Salt*. *Glysters* also are commended, and other outward Applications to comfort the hurt *Fibres*, and to allay the violent motion of the *Animal Spirits*.

XXXV. *The Yellow Jaundise.* The *YELLOW JAUNDISE is an Ill habit of Body, staining the solid and fluid parts thereof with a yellow or black Colour, caused by the effusion of a sharp and depraved Gall.* For the *Gall*, whenever its *Particles* are vitiated, either in their *figure* or *motion*; then that part of it which commonly promotes the Voiding of *Excrements*, is no longer sent that way, but continuing with the *Blood*, and circulating with it through the *Body*, stains the *Skin* with a *yellow*, and sometimes with a *black Colour*, that is, when sowr and gross *Particles* are mixed with those of the *Gall*. Wherefore in this Disease *Purging Medicins* are to be used at first, and particularly Infusions of *Rhubarb* and *Senna*; for otherwise, if they be boiled, or too strongly wrung out, they communicate those *Particles* to the Potion, that after *Purging* strongly bind the *Body*, which may be very hurtful.

XXXVI. *The Dropsie.* The *DROPSY is a Swelling of the whole Body, and more especially of the Belly, caused by a Collection of watry Humours.* For when a *watry Humour* stagnates and grows thick in the *Belly*, then it obstructs the Surface of the *Inwards*, together with the *Peritonæum* and *Muscles* of the *Body*, with a kind of slimy, pituitous Matter, which hinders that the *Vapours* and Steams arising from the *Body*, cannot be evacuated by insensible *Transpiration*; which is the Reason, why those that are troubled with this Disease, are so difficult to be brought to Sweat. Whilst therefore these small *Vessels* are burst and broken by the thick and tough *Particles*, the *serous Particles* drop down into the *Belly*; which being by degrees and continually increased, they produce the *Dropsie*, and other Ills in the *Body*. Wherefore for the Curing of this Disease, *Medicaments* that purge *watry* and *serous Humours*, are commended, as *Pilulæ de Ammoniaco* with *Mercurius Dulcis*; for the *Mercury* resolves tough and slimy *Humours*; and the *Gum Ammoniacum* is proper to consolidate the burst *Vessels*.

XXXVII. *Hypochondriacal Melancholy, or the Spleen.* *HYPOCHONDRIACAL MELANCHOLY*, or the *Spleen, is a painful Sensation, caused by the Grossness, small Quantity, and Unevenness of the Spirits.* For a sharp, sowr, and tough *slimy Humour*, lying hid in the *Belly*, breedeth Obstructions, whence all the Symptoms observable in this *Disease* do proceed. Wherefore also the Cure of this *Distemper*, is endeavoured by *Decoctions* made of the *Barks* of *Tamaruks* and *Cappar-trees*, of the Herbs of *Germander* and *Chamæpytis*, *&c.* If the *Blood* abound with *vitiated Salts*, *volatile Acids*, are commended, *Antiscorbutical Herbs*, and more especially *sulphurated Tartar*. And because *præternatural Acids* generally have a hand in this Disease; therefore all those *Medicaments* are used, that are proper to alter and destroy the same; as the *Alkalisate Salts of Herbs*, *Crabs-Eyes*, *Pearl*, *Diaphoretick Antimony*, *Salt of Tartar*, and other such like.

XXXVIII. *The Scurvy.* The *SCURVY is a Distemper of the Blood, and other Juices of the Body, caused by a præternatural Sowrness, afflicting more or less all the Parts of the Body, and accordingly producing a vast variety of Symptoms.* For the Cause of this *Disease* chiefly consists in that the *Blood* is impregnate with much *fixed Salt*, or *acid Juice*, and is frequently to be imputed to the *Air*, that is fill'd with such like *Particles*; which being drawn in by breathing, communicates the same to the *Blood*, and so forms this *Disease*. The Cure of this *Disease* is performed by *Volatilizing* of the *Blood*, and the fixed *Salt*, and by opening of Obstructions; to which end *Blood-letting* is prescribed, that the thicker part of the *Blood* being evacuted, better *Blood* might be furnish'd instead of it, by introducing of a *volatile Acid*.

XXXIX. *The Stone.* The *STONE is a Disease caused in the Reins or Bladder, by the Gravel or Stone, accompanied with a most exquisite Pain, by their grating against the Fibres of the Kidneys and Ureters.* It is the product either of the too great abundance or thickness of the *Blood*, or the sharpness of the *Humours*. And therefore when the *Patient*, subject to this *Disease*, doth abound with much *Blood*, the *Breathing of a Vein* is necessary, and afterwards the *Gravel* and *Stone* must be evacuated by *Diureticks* and *Lithontripticks*: *Emollient Glysters* are also very much commended, for to make the *Passages* more slippery and open.

XL. *Stranguy.* *STRANGURY, is the continual desire to make Water, accompanied with an extraordinary Pain and Burning, caused by the sharp and pointed Particles that are in the Blood, or the Serous part of it.* But the Cause of *Bloody Urin*, and of all other *Bloody Fluxes*, is the solution of any continuous Parts, caused by sharp and pointed *Particles*, pricking and cutting the Parts. And therefore the *Remedies* most proper for this *Disease*, are such as precipitate these *acid Particles*, or imbibe them, as likewise *Anodynous Medicaments* and *Opiates*.

XLI. *Diabetes.* *DIABETES is a most swift and copious evacuating of the Liquor we drink by Urin, sometimes with little or no change made in it, accompanied with extream Thirst and a Wasting of the whole Body.* For in this Disease the Contexture of the *Blood* is too loose, and the Pores of the *Kidneys* are too open, and the præcipitating *Salt* does too much abound. Some think the *Drink* goes directly by some short Passages from the *Stomach* to the *Kidneys*. Others, that it runs through the *Pores* of the *Stomach* and *Guts* into the hollow of the *Belly*, where meeting with the *Bladder*, it enters its *pores*, and thus is evacuated soon after, without any, or with but little change. In this *Distemper* adstringent and absorbent *Medicins* are commended, especially joyned with *Opiates*, to imbibe that *vicious Salt*, which precipitates the *Blood* too much.

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XLII. *The Gout.* The *GOUT is a pain of the Joints, or parts about the Joints, caused by the various Corner'd Figures of Salts, or Saline particles, which twitch and prick the Fibres belonging to them.* For when uneven and *Saline particles* do abound in the *Blood*, they by their Ruggedness and Points hurt the *Fibres* of the *Nerves*; or the *Saline particles*, by their sharpness twitching and vellicating them, are the Cause of those exquisit *Pains*, which those that are troubled with the *Gout* do endure; and other like *Humours*, impregnated with much the same *Particles*, flowing to the Parts already afflicted, do increase the Pain, which is often accompanied with a swelling and light Inflammation. For the Cure of this *Disease*, ponderous things are made use of, as *Crabs-Eyes*, *Coral*, *Chalybeats*, *Mercurius Dulcis*, as likewise *Sudorificks*, *Topicks*, *&c.*

XLIII. *The French-Pox.* The *Disease* commonly called the *FRENCH-POX, is a Distemper of all the Humours of the Body, consisting in a Volatile Corrosive Acidity, disturbing all the Actions of it, and at last quite corroding it.* For the sharp *saline Particles* that lye lurking in the *Blood* and *Humours*, do produce all the Symptoms that are obvious in this *Disease*. And therefore in order to the altering and blunting of these *Particles*, the *Decoctions* of *Woods* and *Roots*, and *Mercurial Medicins* are prescribed; and for the evacuating of them out of the *Body*, Preparations that cause *Salivation* are made use of, and particularly *Mercurius Dulcis*.

XLIV. *Ague or Fever.* An *AGUE*, or *Fever*, *is an Effervonce of the Blood in the Heart, sometimes exceeding that which is Natural, and at other times less; but ever with greater Malignity.* For when the *Febrifick matter* or *humour*, endued with a *Fermentative quality*, doth from its *Focus* or *Seat*, be it *Mesentery*, or any other part of the *Body*, in which it hath been a long time a gathering, come into the *Veins*, and is mingled with the *Blood*, and with it carried to the *Heart*, it stirs up an *Ague*. For when it is thus communicated to the *Blood*, passing through the *Heart*, the Matter of the *First Element*, which is a great Enemy to our *Blood*, doth greatly shake it, and confound the parts and mixture of it, in which Confusion the Nature of an *Ague* and *Fever* doth consist. Yet it is not every thing that mingles with the *Blood*, doth presently produce an *Ague*; but such Matter only as is of a *Fermentative Nature*, that is, which disturbs the Mixture of the *Blood*. For this *Fermentative Matter* may be compared with *Green-wood* that is laid upon the *Fire*; for as such *Wood*, when once it begins to *burn*, doth burn more vehemently than *Dry-wood*; so the said *Humour* becomes more heated and dilated, than the *Blood* it self in its Natural condition. Hence therefore we conclude, that a *Quartan Ague* is produced, when the Matter, which is the Cause of it, stands in need of the space of 3 Days for its Concoction, before it can be fit to be united to the rest of the *Blood*; a *Tertian Ague*, when 2 Days is enough for this purpose; a *Quotidian*, when it is concocted every day, and mingles with the *Blood*; and *Continual*, with *Exacerbations* or Fits, when the Corrupt Matter doth so much infect the *Blood*, that it cannot rid it self of those defilements from that time, that the last drop of that *Humour* is run out, and that wherein the first drop of that which is gather'd anew begins to enter the *Heart*. For this being the time wherein this depraved *Humour*, and ready to raise an Effervescence, is in greater quantity conveyed to the *Heart*, it must of necessity cause a greater Heat and Ebullition. Wherefore to the end that this *Feverish* Ferment may be expell'd in *Agues*, and more particularly in *Quotidians*, *Vomits* and *Purges* are used, which being exhibited at the Beginning, before the Fits, are found to be very successful in the Cure of them. But if the *Ague* be of long continuance, and the *Stomach* swoln, it is best to abstain from *Vomits*, and instead thereof to give gentle *Purges*; because *Vomits* weaken the *Stomach*. As for *Fevers*, they are commonly Cured by Remedies that *precipitate* and *imbibe* sowr Humours, as *Crabs-Eyes*, *Antimony Diaphoretick*; by such as thin the *Blood*, and make it more fluid, as *Barly-water*, *Whey*, *&c.* by such as open Obstructions, as *Carduus Benedictus*, *Camphire*, *Venice-Treacle*, *Volatile Salts* and *Spirits*. All *Bitter* things are also employed with good success, both in *Fevers* and *Agues*, because they strengthen the *Stomach*, and keep out the the Enemy; so that according to the Report of *Physicians*, *Agues* have frequently been Cured, only be exhibiting the Compound Essence of *Wormwood*.

CHAP. XXIV.

Of Medicaments in General, and of their Operations.

HAving treated of the *Diseases* that afflict the *Body* of *Man*, it remains now that we add something concerning *Medicins*. Now a *Medicament* in general *is that which being applied to the Body of a Sick person, is able by its virtue, to reduce it from a Præternatural state, to a Natural.* I. *What a Medicament is.*

Some *Medicins* are *Simple*, as *Roots*, *Barks*, *Leaves*, *Flowers*, *Fruits*, *Seeds*, *Gums*, *Juices*, *Animals* and their *Excrements*, *Products of the Sea*, *Salts*, *Stones*, *Minerals* and *Metals*: Other are *Compound*; and these again are either *Internal*, which by the *Mouth* are taken into the *Body*: And these again are either *Preparatory*, otherwise called *Digestive*, which prepare and digest peccant *Humours*, in order to their Expulsion, as *Syrups* and *Conserves*; or *Purgative*, which evacuate the Matter that hath been prepared and ripened by the fore-going Digestives, as *Purging Electuaries*, *Pills*, and those the Latins call *Linctus*, and the Arabians *Lohoch*; or *Cordial* and *Corroborative*, which are used to strengthen the *Body* after *Purgation*, or rather when the Violence and Continuance of the *Disease* hath greatly weakned it; as likewise to remove any Obstructions or Distemperature in the Bowels or Humours of the *Body*; and take away the Symptoms of the *Disease* (as *Pain*, *Watching*, *Loosness*, *Swounding*,) such as are *Cordial Confections*, *Powders*, *Troches*. *External Medicaments*, are those that are outwardly applied to that part of the *Body* which is chiefly affected, and therefore are called *Topicks*, because they are applied to the place grieved; such are *Oils*, *Ointments*, *Cerecloaths*, and *Plaisters*. II. *Of the several sorts of Medicaments.*

But to leave the more particular Disquisition into these Matters to *Physicians*, I shall only in a few words speak something of the *Common Medicaments*, III. *Of Medicins Common and Specifick.*

caments, viz. *Vomits*, *Purges*, *Diureticks*, *Sudorificks* or *Diaphoreticks*, *Cordials* or *Alexipharmaccks* and *Opiates*; and then pass to *Specificks*; and briefly declare the Nature of them in general, and the manner of their *Operation*.

IV. *Vomits or Vomitory Medicins.* VOMITS are *Medicins* that evacuate the *Stomach*, and drive out *peccant humours* upwards, and that by drinking *luke-warm Water*, but more readily if some *Oil* or *melted Butter* be mingled with it, which will make the *Stomach* the more to loath it, and therefore the more easily to discharge it. Besides these common things, several *Chymical Preparations* are made use of to this purpose, as *Salt of Vitriol*, *Glass of Antimony*, *Flowers of Antimony*, *Crocus Metallorum*, *Sulphur of Antimony*, *Mercurius Vitæ*, the *particles* of all which *Preparations*, when dissolved, do so violently twitch and affect the *Fibres* of the *Stomach*, as to cause a Convulsive Motion both of that and the Neighbour Parts, *viz.* the *Gut* called *Duodenum*, the *Porus Choledochus*, or Passage that conveys the *Gall*, and the *Ductus* or *Vessel* of the *Pancreas*, by which *Colvulsive motion* whatsoever is contained in them is carried up to the *Stomach*, and from thence to the *Mouth*; and not only so, but by these *Vomits* the serous part of the *Blood* is often drawn out of the Extremities of the *Arteries*, carried up to the *Stomach*, and thence evacuated by the Mouth.

V. *Purging Medicins.* PURGING MEDICINS are such as move and loosen the *Belly*, and drive out the *peccant Humours* in the *Body* of *Man* by *Stool*, such as are *Roses*, *Violets*, *Cassia*, *Manna*, *Aloes*, *Rhubarb*, besides manifold compound *Purgatives*. The reason of the operation of these *Catharticks* is, because they painfully affect the *Spirits* that are in the *Fibres* of the inward parts of the *Body*, and provoke them to excretory contractions; and moreover raise a *Fermentation* in the *Humours*, and thereby produce several fusions and separations of their parts. For tho' *Manna* and *Cassia* and other such like *Gentle Purgers*, which consist of very subtil parts, do not at all, or very little disturb the *Stomach*; yet as soon as they are past the *Pylorus*, or outlet of the *Stomach* into the *Guts*, they begin to irritate and twitch the most sensible *Membran* of the *Gut Duodenum*, and before they get any further, almost spend their whole force there. And because by the twitching and vellication of this *Mmembran*, the *Porus Biliarii* or passage of the *Gall* is considerably shaken, therefore they produce Bilious dejections.

VI. *Purging Medicins do not act Electively.* The opinion of old was, that *Catharticks* purged Humours *Electively*, that is, by choice, as evacuating one *Humour* rather than another: They were induced to be of this Opinion, because they often found that the *Excrements* evacuted by *purging Medicins*, were of a *Yellowish*, and sometimes of a *Blackish Colour*, whence they concluded, that some *Catharticks*, *purged Choler*, and others *Melancholy*, as it were choosing and separating them from the rest of the *Humours*. But this is no better than an error; for tho' there be *purgative Medicins* that evacuate *Choler*, *Phlegm*, *Melancholy* and *Watry Humours*, which gave occasion to *Physicians* to distinguish *Catharticks* into *Cholagogues*, *Phlegmagogues*, *Melanogogues* and *Hydragogues*; as for Example, *Rhubarb* and *Scammony*, *purge Choler* rather than *Phlegm*; whereas *Mercurius Dulcis*, and the *Troches Alhandal*, evacuate *Phlegm* rather than other *Humours*. Yet is not this so to be understood, as if *Scammony*, for instance, purged *Choler* only, without touching any other *Humours*; or *Mercurius Dulcis* only expelled *Phlegm*; for it is certain that it purgeth other *Humours* also, tho' not so copiously as that of *Phlegm*; and therefore some *Purgative Medicins* may well be called purgers of *Choler*, and other *Phlegm*, &c. for tho' they do not purge that *Humour* only, whence they take their denomination, yet they do purge that *Humour* more copiously and signally than any other.

VII. *Diuretickı* DIURETICKS are *Medicins* that purge by *Urin*, such as are the *Roots of Smallage*, *Parsly*, *Radish*, *Bitter Almonds*, *Spirit of Salt* and of *Nitre*, *Juice of Limons* and of *Sorrel*, *White-wine*, *Renish-wine* and *Cyder*; which when taken into the *Body*, do precipitate the *mass* of *Blood*, and separate the Wheyish part from it, which soon after is evacuated. For the *particles* of these *Diuretick Medicins* by their pointedness and thinness penetrate the *Vessels*, and by diluting, inciding and dissolving the *Blood*, cause a great quantity of *Wheyish Matter* to be separated from it in the *Reins*, and to be thence evacuated by the *Ureters*.

VIII. *Sudorificks or Diaphoreticks.* SUDORIFICKS are *Medicaments* that provoke *Sweat*, such as are the *Leaves*, *Roots* or *Seeds* of *Carduus Benedictus*, *Contrayerva*, *Angelica*, or the like, being taken either in *Powder*, *Decoction*, *Conserve* or *Magistery*. The reason of their *Operation* is, because they consist of such *particles* as are very friendly to the *Stomach* and *Guts*, and therefore do not produce any Convulsions or Excretory *Motions* in them; only the *mass* of *Blood* being by them Rarefied and Heated, and consequently more swiftly circulated, do put the *Body* into a *Sweat*. Moreover, the *particles* of these *Diaphoreticks* entring the *Vessels* which are implanted in the Stomach, mix themselves with the *Blood*, and raising a *Fermentation* in it, make it run more swiftly through the *Veins* to the *Heart*, and there entring with some impetuousness, encreaseth the *Beating* or *Pulse* of it, by which means the whole *mass* of *Blood*, being rarefied and enkindled, rusheth more swiftly through the *Arteries* to all the outward parts, which not being able to admit it, nor the *Veins* to send it all back to the *Heart*, a considerable part of the *serum* of the *Blood* is evacuated through the *Pores* by *Sweat*.

IX. *Cordials.* CORDIAL MEDICINS are such as are proper to restore and kindle the interrupted or weakned *Fermentations* of the *Blood* in the *Heart*. Wherefore these *Remedies* are not called *Cardiaca* or *Cordials*, because they are appropriated to strengthen and comfort the *Heart*, as are all things that are *Spirituous* and *Volatil*, such as *Saffron*, *Wine*, especially to those who are not accustomed to the *drinking* of it, and Strong *Waters*. The reason of which *operation* is because their *Volatil Particles* entring the *Blood*, separate all *Heterogeneous* and *Malignant Particles* from it. Neither is the Passage from the *Stomach* to the *Blood* so long, that there should be need to fear that the virtue of these *Medicaments* would be lost by the way. For it is evident that the inward *Nervous Coat* of the *Stomach* is all interwoven with multi-

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tudes of *Veins* and *Arteries*, ſo that *Medicaments*, not only *Purgative*, but any others may exert their operations upon the *Blood*, before ever they paſs out of the *Stomach*.

X. *Opiats.* OPIATS are thoſe *Medicines* which have *Opium* for their *Baſis* or chief ingredient, and are proper for the laying of Noxious *Vapours*, and aſſwaging of Grievous *Symptoms*, for the ſtrengthning of the inward parts, the removing of *Pain*, and recruiting of the *Animal Spirits*. The manner of their performing theſe effects is this, the *particles* of theſe *Medicines* do put a ſtop to the outgoing or efflux of the *Animal Spirits* and ſuppreſs them; ſo that during the operation of the *Opium*, they do ſlow much more ſparingly to the inwards and other parts of the *Body*. And accordingly the *Pulſe* of the *Heart*, and *Reſpiration* are diminiſhed in their ſwiftneſs and force, and ſometimes cauſe a difficulty of *Breathing*, and a weakneſs of the *Pulſe*, with a liſtleſneſs to move, and drowzineſs over the whole *Body*.

XI. *Why the Author treats of Specificks.* Next after the *common Medicins* follow SPECIFICKS, whoſe *Virtues* diſcovered by Experience, are conſiſtent with the *Principles* of our *Philoſophy*, and may be perſpicuouſly unfolded by them. Some *Galeniſts* indeed have altogether rejected *Specificks*, probably becauſe they found themſelves unable to explicate the manner of their operation.

XII. *What a Specifick is.* The word *Specifick* is by *Phyſicians* uſed in a threefold Senſe; for ſome call that a *Specifical Medicin*, which is peculiarly friendly to ſome particular part of the *Body*, as to the *Heart*, *Liver*, *Brain*, &c. Others call that a *Specifical Medicin*, which by a peculiar Quality doth evacuate ſome determinate *Humour*, as *Rhubarb* and *Caſſia* are ſaid to Evacuate *Choler*; *Senna*, *Melancholy*; *Jalap* and *Diagridium*, *Seroſities* and *Phlegm*. But more frequently that is called a *Specifical Medicin*, which peculiarly cures ſome particular *Diſeaſe*, as the *Pleuriſie*, *Tiſſick*, *Colick*, *Dropſie*, and in this *Senſe* I take it here.

XIII. *Whether there be any Specifical Medicins.* It may therefore be enquired, whether there be any ſuch *Specifical Medicins*. Some *Dogmatical Phyſicians*, leaning too much upon the Principles of the *Scholaſtick Philoſophy*, will admit of no *Medicinal Virtues* that cannot be reduced to their manifeſt Qualities: But GALEN ſomewhere complains of theſe Men, that they either plainly deny matter of Fact, or elſe aſſign ſuch cauſes to theſe effects as are not ſufficient to explain them. So that not only *Galen*, but many other Learned *Phyſicians*, both Modern and Ancient, do maintain that there are *Specifick Medicins*.

XIV. *The effects of Specificks may be explained Mechanically.* It may alſo be queried, whether the effect of *Specificks* are *mechanically* explicable, that is, whether they be conſiſtent with the *Principles* of *mechanical Philoſophy*; to which I anſwer, that the *Principles* of the ſaid *Philoſophy* are of ſuch a vaſt comprehenſion, that he who conſiders it, will not at all queſtion, but that the effects of theſe *Medicins* may be explained in ſuch a manner, as ſhall not in the leaſt contradict the ſaid *Principles*.

XV. *In order to the explaining of the Effects of Specificks, the* To make out this we are to obſerve, that the *Animated Body* of *Man* is not to be conſidered as a meer *Statue*, as if it were nothing elſe but a dead heap of ſeveral parts and matters whereof it conſiſts; for to ſpeak the truth, it is a moſt wonderful and curious *Machin* or *Engin*, compoſed of fixt, liquid and ſpirituous *Subſtances*, with ſuch exquiſit *Artifice* joined together, that frequently we cannot judge ſo well concerning the action of an Agent that acts upon it, from the *Power* and forces of the *Agent*, conſidered in it ſelf, as by the effects proceeding from it, becauſe of the mutual action of the parts of this *Living Machin* upon each other. *make or ſtructure of Mans Body is to be noted.*

XVI. *Another thing to be noted about the operation of Specificks.* It is likewiſe to be obſerved from the learned Mr. BOYLE, that it is not neceſſary that the *Operations* of all *Specificks*, or of the ſame in differing *Diſeaſes*, muſt be of one kind; but differing *Specificks* may operate in ſeveral manners. And of theſe general ways he has propoſed ſuch as follow, premiſing only, that the *Specifick* Remedy do's not commonly, tho' ſometimes it may, relieve the Patient by this or that ſingle way of Operation, but by a Concurrence of two or more, that as it were join their forces to produce the deſired effect.

XVII. *The firſt way or manner whereby Specificks perform their Effects.* *Specifick Medicins may ſometimes cure by diſcuſſing or reſolving the Morbifick matter, and thereby making it fit for expulſion by the greater Common-Shores of the Body, and the Pores of the Skin.* For it is moſt notorious, that a great many *Diſeaſes*, and thoſe very obſtinate and *Chronical*, are cauſed by ſome *tough* and *ſlimy Humours*, which obſtruct the *Paſſages*, and ſo hinder the *Circulation* of the *Blood*, and the free motion of other uſeful *liquors*; which peccant *Humours* are ſometimes ſo exceeding *Glewy* and *Ropy*, that they will not give way to common *Remedies*. Whereas the *Specifick*, by the minuteneſs of its *Parts*, and the congruity of their *Figure* with the *Pores* of *Morbifick Matter* may be able to penetrate and reſolve it, with the concurrent heat of the *Patients Body*, and thereby diſpoſe for an evacution by *Urin*, *Sweat* or otherwiſe, as Nature finds moſt convenient. So that the *Blood*, or ſome other *Liquor* of the *Body* being impregnated with the amicable and *Active Particles* of the *Matter*, may be a *Menſtruum* to diſſolve the peccant matter; even as common Water impregnated with *Salt Armoniack* becomes a *Menſtruum*, which by degrees will diſſolve *Copper* and *Iron*.

XVIII. *The ſecond way or manner.* Sometime a *Specifick Medicin may mortifie the too over Acid, or other immoderate Particles that infeſt the maſs of Blood, and deſtroy their Coagulatory or other Effects.* For ſeeing that moſt *Diſtempers* do ariſe from *Acids*, and their *Malignant Effects*, it is very probable that all ſuch *Diſeaſes* may be cured, or much alleviated by ſuch a *Remedy* as abounds with *particles* proper to mortifie the ſaid *Acid Juices*. Which *Mortification* may be effected theſe two manner of ways: for there are ſome *Bodies* which deſtroy *Acids* by a *Poſitive Hoſtility*, that is to ſay, by ſuch a contrariety as is diſcernible by the *Taſte*, and by a conſpicuous fight or conflict they maintain with the *Acid Juice*: Of this kind are all fixed *Askalies*, *viz.* the *Lixivous Salts of Plants*, and all volatil *Alkalies*, as *Spirits of Harts-horn*, *Salt Armoniack*, &c. Another way whereby *Acids* may be mortified or dulled is, when their *Particles* are, as it were, *ſheathed* or blunted; for as a *Knife* may be diſabled to cut, either by filing or otherwiſe blunting its Edge, or elſe by covering the Blade with a Sheath fit for it; ſo an *Acid* Compound may loſe

its power of cutting or pricking, when an *Alkali* alters its *Figure*, or when its sharp *particles* are, as it were, sheathed in the *Pores* of some other *Body*, tho' it may be the said *Body* may be wholly without *Taste*, or any considerable manifest quality by which it might appear contrary to the sowr *Juice* it enervates, as a File is contrary to the Edge of a *Knife*.

XIX. *The third manner.* *A Specifick Medicin may sometimes help the Patient by precipitating peccant Matter out of the Blood, or other Humours of the Body.* Thus SENNERTUS seems to intimate that in some cases the *Disease* is vanquisht by a precipitation of the *Aguish Matter*. And KERGERUS in his Treatise of *Fermentation*, *Sect.* 3. *Cap.* 3. tells us in plain terms, that he had cured above 1000 persons of *Agues* without *Blood* letting, *Purging*, *Diaphoreticks*, *Diureticks*, altering *Medicins* or *Topicks*, only by means of one *precipitating Medicin*. Neither need we to fear any danger in these *precipitations* by the *particles* of the *Medicin* entring into, and spoiling the Temperament of the Blood; because it is certain that *Heterogeneous Matters* in the *Blood* may be precipitated by means of *Remedies* which never enter the *Blood*: For *Physicians* often exhibit *filings* of *Steel*, and other preparations of that *Metal*, to mortifie the *Acidities* of the *Blood*, and yet we have no reason to believe that the said metalline *particles* ever enter the *Blood*.

XX. *The fourth manner.* *Sometimes Specifick Remedies exert their effect by a peculiar corroborating of the Heart, and by that means, or without it, the Parts affected.* For seeing that the *Heart*, *Brain*, *Liver*, *Kidneys* are all of them of a peculiar make and structure, and so likewise the liquid parts, as the *Gall*, the *Blood* and the *Lympha*; it may happen that the *particles* of a Remedy dissolved in the *Stomach*, and carried up and down the *Body* in the Vehicle of some of its Liquors, may according to their determinate *Figure*, *Size*, *Stifness*, *Flexibility* or *Motion*, &c. be more fit to be admitted in some one part of the *Body*, as the *Brain*, *Heart*, &c. than another, and so by continuing in the *Pores* thereof, and associating themselves to the *Fibres*, or furnishing it with some *particles* it wants, may strengthen the *Tone* of that *Part*, and enable it to resist the action of the *Morbifick* matter, and expel it.

XXI *The fifth manner.* *Sometimes a Specifick Medicin may exert its operation, by producing such a Disposition in the Mass of Blood, as may enable Nature by correcting, expelling, or other fit ways, to overcome the Morbifick matter, or other cause of the Distemper.* For seeing that as most of the *Diseases* incident to *Mans Body*, are produced by a vitiated constitution of the *Blood*, so the recovery of it to *Health* and *Soundness* depends on the restoring of it to its former state; a *Specifick Medicament* may divers ways effect this advantageous change of the *Blood*. As *First*, by furnishing the *Blood* with some very active *particles*, by which means it will not be necessary for the *Midicament* to raise any *Fermentation* in it. *Secondly*, A *Specifick* may be of great use in restoring the *Mass* of *Blood* to a laudable state, by dilating and attenuating or thinning of it. For when the *Blood* is too thick, as frequently it is, it cannot so freely pass through the *Capillary Vessels*, whence an obstruction will follow in them, whereby the *Circulation* of the *Blood* will be retarded, and great inconveniencies accrue to the *Body*. And on the other hand, if the *Blood* be too thin, especially if it be overmuch agitated, it will easily run out of the *Vessels*, and produce various *Fluxes of Blood*, and other dangerous effects, that commonly accompany the extravasation of the *Blood*. Now a *Specifick Medicin* may correct this vitious consistence of the *Blood*, by furnishing it with such *Particles*, which by their *Figure*, *Bulk*, *Motion*, &c. may subdue those *vitious particles* that thicken the *Blood*, and attenuate them; or by dividing the *parts* of it dispose it to a greater degree of *Fluidity*. And when the *Blood* is too thin, which is the effect sometimes of *Diseases*, and sometimes of certain *Medicaments*, and more particularly of *Aloes*, a *Specifick* in this case may afford such *particles*, as by their easie complication and infolding one another, may curb the too active *particles* of the *Blood*, which do too much attenuate it, or it may assist the expulsion of the said *particles* by *transpiration*, or any other way. *Thirdly*, a *Specifick* may be helpful to restore the *Mass* of *Blood* to its former good state, by some particular *operation* it may exert upon the *Heart*, by strengthning the *Tone* and Vigor of it, so as that it may be able to transmit the *Blood* to the greater advantage and welfare of the *Microcosm*.

XXII. *The sixth manner.* *Sometimes also a Specifick may unite its particles with those of the Peccant Matter, and with them constitute a Neutral Matter, that may be easily, or is not needful to be expelled.* As when the *Blood* being impregnated with an *Acid Juice*, hath lodged the same in some stable part of the *Body*, as in the *Liver*, *Spleen* or *Kidneys*, &c. In this case the *particles* of the *Specifick* may without any sensible contest or effervescence, when manifest *Acids* are mortified by such like *Alkalies*, so combine themselves with the *particles* of the vicious *Acidum*, as to make one compound with them, which differing from the *particles* of the *sowr Juice* in *Motion*, *Figure*, *Solidity* and *Stiffness*, or in one or more of the same, must needs constitute a *substance* of a Different *Nature* from the said *Acid particles* before that they were corrected.

XXIII. *An Advertisement concerning Specificks.* It was noted before, that when it was said that a *Specifick* doth cure a *Disease*, it is not to be understood as if a *Specifick Remedy*, or Nature by means of it, did for the most part *cure* Distempers by one only of the propounded *Modes*, seeing that two, or more of them may concur to produce this effect. Besides, I have only here undertaken to explain the operation of *Specificks* in General; but never asserted that the *ways* and *modes* by me propos'd, to be true and genuine, but only propounded them as so many probable ways whereby *Specificks* may produce their effects. Wherefore these things are not *Dogmatically* asserted by me, but only delivered by me as Possible or Probable *Explications*, my chief design being only to evince thereby, that the *Operations* of *Specificks* are congruous to the *Principles* of *Mechanical Philosophy*.

XXIV. *An Objection against Specifick Medicins answered.* There is an *Objection* the Rejecters of *Specifick Remedies* usually urge against them, which is, that by being taken into the *Stomach* and *entrails*, they are greatly changed by *Digestion*, and mixture with the *Aliments*, a good part of them sent away

away by *Excrement*; and that as ſoon as they are got out of the *Stomach*, they paſs through manifold Strainers of different *Textures*, which in all probability ſtop the greater part of the *Medicinal Particles*. But this Difficulty will diſappear, if we conſider that *Rhubarb* tingeth the *Urine* of thoſe that have taken it, many hours after, with a *Yellow Colour*. That *Elaterium* eaten by a *Goat*, communicates a *purging* quality to its *Milk*, ſo as to *purge* a *Child* that takes of it. For the *particles* of ſome *Bodies* do very obſtinately retain their *Figures*, and do not eaſily quit their *virtue*. For if a *Medicament* exerts its activity by impregnating the *Blood*, or any other *Liquor* in the *Body*, thereby turning it into a kind of *Menſtruum*, it may ſo happen that the ſeveral *Strainers* through which the *Particles* are to paſs, may ſtop the leſs fit parts of the *Vehicle*, ſo as to make the *Menſtruum* more appropriate to the overcoming of the *Peccant Humour*, or that at leaſt thereby it may be ſo changed as to reſtore this *Subſtance* in the *Body* of a *Man* rather than another. And tho' there may but a ſmall quantity of the *Medicinal Matter* reach to the part, on which it is to act, yet ought not we to queſtion the effect upon that account, ſeeing that the efficacy of *Natural Agents* upon the *Body* of *Man* is not to be meaſured by their *Bulk* or *Quantity*, but by their *Activity* and *Subtilty*.

XXV. *An Objection concerning Topicks.*

An *Objection* may be alſo made againſt what hath been here aſſerted concerning the *Operation* of *Medicaments*, that all *Topical Medicins*, eſpecially ſuch as are applied to the *Wriſts*, *Amulets*, and things hung about the *Neck*, or only outwardly touching any other part of the *Body*, cannot afford ſufficient *Medicinal Particles* for coreſting of the *Peccant Matter*, or ſubduing of the *Diſeaſe*. For an Anſwer to this Objection, it will be ſufficient to conſider that the *Skin* of *Mans Body* is very full of *Pores*, by which the more *ſubtil particles* of the *Remedy* may enter; as is *evident* from manifold *inſtances*. *Water* penetrates the *Pores* of the *Bladder*, and diſſolves the *Salt of Tartar* or *Sugar* contained in it. *Quick-ſilver* mixed with *Ointments*, and outwardly applied, inſinuates it ſelf through the *Pores of the Skin*, into the moſt inward *parts* of the *Body*, where it often produceth moſt violent *operations*. Neither can it be difficult to conceive how the *particles* of any *Specifick* being once got into the *Pores*, may further diffuſe themſelves throughout the *Body*, foraſmuch as near the *Cuticle* or thin outward Skin of the *Body* there be many *Capillary Veſſels*, which tho' very ſmall, yet have their Cavities continuous with other greater *Veſſels*, and it will be eaſily underſtood that the *particles* of the *Medicament*, being once entred into theſe *Capillary Veſſels*, will by the *Vehicle* of the *Liquors* contained in them, be tranſmitted to the Branches of the *Principal Veins*, and ſo by means of *Circulation* be mingled with the whole *maſs* of *Blood*, and with it conveyed to all parts of the *Body*.

XXVI. *Whether there be any Medicaments appropriated to any particular part of the Body.*

The only difficulty that remains now to be removed, is whether there be any *Medicaments* that are appropriate to this or the other particular part of the *Body*? To which I Anſwer, that there is no impoſſibility nor improbability in it, that the *Particles* of a *Specifick Medicament* ſhould be deſtinated more to one part of the *Body* than to another, ſo as not only to ſtrengthen it, and preſerve its ſound Conſtitution, but to reſtore it to its former ſtrength and vigor, when weakned by any Diſeaſe or Diſtemper: Foraſmuch as by their particular *Texture*, *Motion*, &c. they may in a peculiar manner prepare the Moleſting Matter for *Expulſion*, and withall ſo work upon the *Fibres* of the *Part* affected, as both to *Enable* it, and *Excite* it to free its ſelf from its Enemy.

The

The Ninth Part
OF THE
INSTITUTION
OF
PHILOSOPHY.
OF
MAN,
Considered in the other PART,
The MIND.

CHAP. I.

Of the Nature of Human Mind, and that it is more Evidently perceived than Bedy.

I. *That too much Credit is not to be given to our fallacious Senses.*

SINCE we have often been deceived by our *Senses*, and the *Images* of *things* have been impos'd upon us, which differed from the *Objects* whence they proceeded, or whence we *imagined* they proceeded; and since in our *Dreams* we have seem'd to behold some things, which nevertheless were far enough off from us; and to hear *things* which in no wise smote the *Organs* of our *Hearing*: We have hereupon sufficient *Cause* to suspect that *Corporeal things* are not always such as we apprehend them to be, and consequently that we have sufficient *reason* to doubt of their *Existence*, forasmuch as *Natural Reason* dictates to us, that we are not to trust those *things* which have at some time or other deceiv'd us. Wherefore we may doubt whether there be a *Heaven*, *Sun*, or *Stars*; whether those *Bodies* which are about us are *real*; whether we have *Body*, *Feet*, or *Arms*, in regard we have oftentimes in our *Dreams* seem'd to make use of them, whenas at the same time, deep *Sleep* hath bound us fast, and rendred us immoveable.

II. *The Existence of Human*

But though we may doubt of the verity of *Corporeal Things*, yet we cannot doubt but that we have an *Existence*, so long as it is certain we *doubt*; for it is impossible that any one should *doubt* or *think*, and at the same time not be. Whence this Proposition, *I think therefore I am*, is the first certain *Conclusion* we can possibly make, when we muster up our *thoughts* in Order; whence it is inferred, that our *Mind* is more *known* to us than our *Body*, in regard whatever doubt we make of other *things*, we cannot but Be so long as we *Doubt*. *Mind is inferr'd from hence, That we are.*

III. *The Soul is not any thing belonging to the Body.*

For if I attentively weigh and examin who *I am*, who *write* these *things*, who *see*, who *hold* the *Pen*, who draw the *Lines*; I know for certain, that were the use of my *Hands* taken away, my *Eyes* digg'd out, and my *Fingers* cut off, I could neither *write*, *see* nor *touch*; but nevertheless should find it apparent that I yet *Exist*; and suppose I were depriv'd of all *Exterior Senses*, yet still *I am*, so long as I *think*: For my *Body* may be dissevered into divers *parts*, and none of those *parts* be remaining with which I am encompass'd, since I am not all *Heart*, nor *Brain*, nor *Liver*, nor any other of those *parts* which constitute the *Body*; yet nevertheless something of me may be remaining, which makes use of those *parts*, and with which it is surrounded as with a *Garment*.

IV. *What it is to think.*

The *Existence* of *Human Mind* being thus explain'd, we are now to inspect what it is, or rather, who that *I* is, who have a clear conception, that I *am*, and do doubt of the *Existence* of others. For am *I* any *thing*? surely *I am*. What then, I am a *Thinking*, *Knowing*, *Imagining*, *Perceiving*, *Willing*, *Affirming*, *Denying Thing*; for I know that I *Perceive*, I imagine that I *Behold* many things, I am sensible that

G. Freman In. *I. Kip Sculp.*

To the Worship-
-full John Hervey
of Ickworth in the
County of Suffolke Esqr.
This Plate is humbly
Dedicated by Rich: Blome

To the Worshipfull
Sr Edward Hewitt Knt
This Plate is humbly
Dedicated by his most
Obedient Servt
Will. John Herring
Curate of Sutton Essex
Delineavit et Sculpsit.

V. A Definition of the Human Mind.

VI. Why a Thinking Being is said to be finite.

VII. What is to be understood by the name of Cogitation.

VIII. The Soul thinks even in Sleep.

IX. Why we remember what we Dream.

that many *things* are conveyed from their *Objects* to my *Senses*, I affirm that I am a *Thinking thing*, I deny that *Corporeal things* do certainly *Exist*, and am conscious to my self of them all; but I am more certain that I *am*, since it may come to pass, that all those *things* of which I *Think*, may be no where *Existent*; but it cannot be otherwise, but that I must needs *be*, who appear to *Behold*, to *Affirm*, to *Deny*, to *Will*, *&c.*

V. *A Definition of Human Mind.* *Human Mind* therefore may rightly be defined a *Thing thinking by a certain peculiar way, finite, and as it were, by mutual Covenant joyned to a Body well disposed.* And herein it differs from an *Angel*, or *Spiritual intelligence*, which is indeed apt to assume a *Body*; but not so firmly inclining to it, as to *desire*, as the *Human Mind* doth, to have it intimately united.

VI. *Why a Thinking thing is said to be finite.* But it is called *Finite*, because tho' a *Human Mind* always *Thinks*, yet it *Thinks* not of all *things*, nor penetrates immediately into those *things* of which it *Thinks*. Moreover it *Wills* many *things* which it attains not to, all which are *Arguments* of imperfection, from which the *infinite Mind*, that is to say, *God Almighty* is absolutely free.

VII. *What is to be understood by the name of Cogitation.* By the name of *Thought* is understood that *interiour Sense* and *Conscience* by which we are certain of all those *things*, which we *Act* or *Suffer*; so that to say that *Human Mind* is a *Thinking substance*, is no other thing than to say, that there is in it a *Conscience*, or *Co-discerning* of all *Cogitations*, *Wills*, *Appetites* and *Sensations* which are found therein; whether it be their *Principle*, or *suffers* from others: For certain it is, that whatsoever is in us which depends not upon the *Cogitations* of the said *Mind*, belongs not to it. Whence the simple *Cogitation* of *Human Mind* may aptly be defined to be, *an implanted Action of Human Mind: Whereof the said Mind by its own testimony is conscious.* In the first place, *Cogitation* is said to be something *implanted* in the *Mind*, because it is indeed the very *Essence* of the *Mind*. *Secondly*, It is said to be *by its own testimony conscious*, in regard every *Mind* hath its own *Cogitation* so known, that tho' there should be a doubt concerning other *things*, yet the *Cogitation*, it self can never be called into doubt; since the *doubting*, nay the very Erring *person* must of necessity *Think*.

VIII. *The Soul Thinks even in Sleep.* Some difficulty may haply arise from the foresaid *definition* of the *Mind*, as if *Human Mind* be a *Thinking substance*, that is, *Willing*, *Nilling*, *Doubting*, *Perceiving*, *&c.* it should always *Think*, which seems a thing impossible to any one that is *asleep*, since then we cannot be conscious that we do *Think*. To this I answer, that nothing occurs to us in *Sleep*, which directly or indirectly proceeds from the *Soul*, whereof we are not conscious; and tho' our *Soul* in the midst of *Sleep* may *Think*, but negligently, yet it is not to be thought totally destitute of all *Cogitation*: By the same *reason* almost as when it is said, that there is no part of the *World* which is at any time totally void of all *Motion*, tho' some parts may be said to *Rest*, by reason of the more slow and insensible *Motion*, and may seem as it were deprived of all *Motion*.

IX. *Why we remember not our Cogitations.* It may haply be urged, if this were true, we could not but remember at least some of those *Cogitations*, but we dayly experience the contrary. I answer: It is one thing to be conscious of our *Thoughts*, and another thing to remember them; for there is more required to the remembring of any thing, than to the being conscious thereof; for to remember a thing so long as the *Mind* is joyned to the *Body*, it is requisite that the *Species* or *Image* thereof should have its *Vestigia* or *Footsteps* in our *Brain*, upon which we afterwards reflecting should remember; but to *Think*, it is sufficient that we are conscious of our *Perception* or *Cogitation*, which happens not only to persons *Sleeping*, but even to *Infants* in the *Mothers Womb*. Since doubtless those very *Infants* have many *Cogitations*, and their *Minds* taken up with *Idea's* of *Heat*, *Cold*, *Titillation*, *Pain*, *&c.* which proceed from the Union of the said *Mind* with the *Body*; however they remember not afterwards what they *Thought*, or *suffered* at that time.

X. *Whether the Power of Thinking sufficeth for the Mind to be called Cogitant.* If it be alledged that it is sufficient for *Human Mind* to be called *Cogitant*, for that it hath the *power* to *Think*, and not for that it always actually *Thinks*: As a *Potter* hath a faculty always of forming *Pots*, *Pitchers*, *&c.* yet nevertheless for want of *Clay*, or the *Potters Wheel*, cannot always reduce his *Power* into *Act*; so it suffices, that there be implanted in the *Mind* a *Power* to *Think*, tho' it do not always actually *exercise* that *Power* for want of *Matter* which should occur, or through the defect of *Organs* which are hinder'd in *Sleep*.

XI. *The Answer.* The Answer is easie; for there is no necessity that the *Potter* should always actually *Operate*, by reason he *Acts ad extra*, or Externally, and requires *External Matter* for those things he is to form; but *Human Soul* in its *Operations* wants no *Object* to tend unto: For if all things which are to smite the *Senses* of the *Body* were removed, it would yet have the *Idea* of it self, and of all those Verities which we term *Nota per se*, or known of themselves, and consequently *Human Mind* cannot but always *Think*; and certainly it seems to imply a contradiction, that that *Spiritual Part* of ours, so long as it hath an *Existence*, should not *Think*, since it is no other than a *Thinking thing*, and we can conceive nothing in it besides *Cogitation* or *Thought*.

XII. *Soul is opposed to Body as Act to Power.* For the difference between *Matter* and *Soul* is, that that is the *Potentia* or *Power*, this the *Act*; so that *Cogitation* must needs be always present in every *Intellectual thing*, but *actual motion* is not always requisite in *Body* or *Matter*, in regard its Nature is Sluggish and Idle, that it comprehends *Potentiality* or *Power*, and not *Act*; but for a *Soul* to be without *Act* or *Cogitation* implies a Contradiction, since if you take away *Cogitation* from it, there will remain nothing in it of positive and absolute, by which it may be said to *Exist*.

XIII. *Human Mind cannot be without Cogitation.* I know that some will object, that *Human Mind* may be without all *Cogitation*; but this we absolutely deny: For if it should so happen, it would either so happen, because it hath not a *Power* or Faculty of *thinking*, or because it will not have such a Faculty or Power. If it hath not such a power, its *Essence* is destroy'd, in regard it consists in *Cogitation*; but if it will not, that very thing is an inference that it doth *think*, since to *Will* and *Nill* are *Modes* of *perceiving*; for we undergo no greater difficulty in conceiving that the *Soul* must needs always *think*, than in conceiving the *Light* must needs always *Shine*; and that *Heat*

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not but be always *Hot*, for as much as it belongs to the *Essence* of the *Soul* to *Think*, as it belongs to *Light* to *Shine*, and *Heat* to *Warm* or make *Hot*; for a Faculty supposes something real, and *Existing* in *Nature*; or if we well attend to our *Conception*, it is no other than a thing really mutable and capable of divers *Modes*; So that as the faculty of receiving *Figures* in the *Body*, is meer *Extension*, so the faculty of *Thinking* in the *Mind* is meer *Cogitation*, so far as it may be applied to divers *things*, and by divers *ways*.

XIV. *To think is no less Essential to Human Mind, than to be Extended is to the Body.*

Moreover the *Actual Cogitation* of the *Soul* may be proved by comparing it to the *Body*; for as it cannot be granted to be a *Body* which is not extended; that is, which hath not an *actual* and *determinate Figure*; In like manner *Human Mind* must of necessity have some *Cogitation*, which in a manner is its *Life*; but that *Childeren* and *Infants* in the *Mothers Womb*, should not afterwards remember their *Cogitations* in that *State*, need not be any matter of wonder, since in *Persons* of more adult Age, there may possibly sometimes remain no memory, not only of *things* which were represented in *Sleep*, but also even of those *things* which have been acted or thought on *Waking*.

XV. *Cogitation is either taken for the thing Thinking, or for the Modes of Thinking.*

It will yet more clearly appear, that *Cogitation* belongs to the nature of *Human Mind*, if *Cogitation* be in a twofold acceptation considered, first as it is that which constitutes the *Nature* of an *immaterial thing*, and then it is no other than that *thing* which *Thinks*; in another sense *Cogitation* may be taken for divers *Modes* of *Thinking*, in as much as *Substance* is capable of *Exciting* divers *Cogitations*, for the *Thinking* Nature hath power from it self to draw forth such or such *Acts*; nevertheless it is not thence to be inferr'd, that a *Thinking Substance* is something universal, containing all the *Modes* of *Perceiving*: No more than it can be said, that a *Body* is something common containing all *Figure*; because *Cogitation* is not a Universal, but a particular Nature which admits all those *Modes*, as *Extension* is a Nature receiving all *Figures*; for we may very well conceive a *Cogitant Nature*, tho' all its *Modes* are not known, yet they cannot be understood without the said *Cogitant Nature*. For if I *Imagin*, if I *Will*, if I *Remember*, *Cogitation* appears in all these *things*; yet on the contrary, if I *think*, there is no necessity that there should be any one of these in particular, and consequently *Imagination*, *Remembrance*, *Volition* are only divers *Modes* of *Thinking*, even as *Figure*, *Motion*, *Site*, *&c.* are divers *Modes* of *Extension*, or of a *thing Extended*.

XVI. *Mind is Cogitant as Matter is Extense.*

Wherefore we must conclude, that the *Essence* of *Mind* is placed in *Cogitation* in the same manner, as the *Essence* of *Matter* consists in *Extension*, and according to the various Modifications of *Cogitation*, *Mind* is always *Willing*, *Imaginant* or *Sentient*; in like manner, as according to divers Modifications of *Extension*, *Matter* assumes the Form sometimes of *Water*, sometimes of *Fire*, sometimes of *Fewel*, or infinite other particular *Forms*; and consequently as a piece of *Wax* may be changed into divers *Figures*, and be *Round* or *Square*, not without varying its *Nature*; so *Human Mind* remains one and unvaried, although it may be altered divers ways, and may be mutable by a different Application of it self to *Heaven*, for example sake, *Earth*, *God*, *Angels*, *&c.* because tho' it be limited and finite, yet it is not determined to any thing certain, and consequently *Thinks* or perceives all *things* which are deeply inherent in it.

XVII. *The Soul or Mind is the cause of individuation to the whole Man.*

I have heretofore in several places said enough to shew, that the *Soul* or *Mind* is a certain substantial *Form*, when as all other Forms are nothing else but certain rangings and dispositions of Parts. Nor must I now omit to declare openly, and in most expres Terms, that it is that which *individuates* a *Human Body*, or rather *Man* himself, and does principally and essentially make one to differ from another. For as the whole *Essence* of a *Human Body* in general, consists in a certain *disposition* to receive a *Human Soul*; and the particular *Essence* of each *Body*, as for instance the *Body* of *Peter*, is founded in a particular *disposition* it hath to receive its own proper *Soul*; supposing that in some part or portion of Matter, should be found the same essential *disposition*, which that *Body* had wherewith *Peter* was Born, it cannot be otherwise, but that it must be a *Human Body*, even the *Body* of *Peter* himself, and the very same in number wherewith he was Born; forasmuch as it hath the same essential *Form*, or principle of *Individuation*: And also if the same *Soul*, to wit *Peters*, were actually united thereto, it is necessary for the same reason that there must be a *Man*, yea, *Peter*, and the same numerical *Peter* that was before.

CHAP. II.

That Human Mind is distinguisht from the Body, and is Spiritual and Immaterial.

I. *The Mind is to be distinguisht from Body.*

THAT the Immateriality of *Human Mind* may the more clearly be discerned, it will not be from the purpose to explain more at large the *Essence* of *Mind* and *Body*, and shew wherein they may be exactly distinguisht.

II. *In every thing a principal Attribute is given from whence other things proceed.*

They who have most deeply searcht into the Nature of *things*, have observ'd among the *Attributes*, which constitute the *Essence* of any *thing*, that there is one *primary Attribute*, which in a manner gives a *being* to it, and from whence all the rest flow as from a *Fountain*: As *Cogitation* in respect of *Human Mind*, for as much as all things which are found in it presuppose *Cogitation*; for *Imagination*, *Volition* or *Will*, *Sensation*, *&c.* are only different *Modes* of *Cogitation*, which spring from it, as from its Root: For to *Imagin* is another *Mode* of *Thinking*, than to *Will*; and to *Will*, another *Mode* of *Thinking* than sensation. In like manner *Extension* is the first *Attribute*, which constitutes a *Corporeal thing*, and from which all the rest are derived, for as much as all things which attend it, presuppose *Extension*; for whatsoever hath *Figure* is *Extense*, whatsoever can be divided is *Extense*, and whatsoever is contained in place is *Extense*; so that *Cogitation* and *Extension* constitute the Natures of *Intelligent* and *Corporeal Substance*.

III. *An Objection from the confused Idea of a thing Extense and a thing Cogitant.*

If any one urge, that there are *Idea's* granted which involve *Cogitation* and *Extension* together; for Example, the *Idea* of *Pain*, *Colour*, *&c.* for whosoever is sensible of *Colour*, *Pain* and other *Idea's* of the *Senses*, or does but imagin them,

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Extenſion muſt needs occur to him with ſuch a *Perception.* Who is able to perceive *Whiteneſs*, or any other *Colour*, without *Extenſion?* Wherefore if *Idea's* be granted, which are compounded of *Cogitation* and *Extenſion*; what hinders, but that we may judge that there is in the thing it ſelf ſomewhat like to that *Idea*; that is to ſay, that *Cogitant* and *Extenſe* may be in the ſaid Thing at the ſame time?

IV. *Compoſition takes not away Diſtinction of Parts.*

I Anſwer, that by this Argument *Cogitation* is not concluded to be one in *Reality* and *Eſſence*, with *Extenſion*, but only in *Compoſition.* So that *Cogitation* and *Extenſion*, or a *thinking* and *extended Subſtance*, conſtitute one *Compound*, ſo far as there are found therein divers Modifications of *Cogitation* and *Extenſion*; which together, and in one act are attain'd by the *Senſes*, and alſo by *Imagination.* And in Truth, if the Matter be narrowly weighed, it will appear that thoſe *Idea's* of *Senſes* and *Imagination*, in which *Extenſion* is joyn'd with *Perception*, afford us no other Notion, than that *Cogitation* and *Extenſion* have an *Exiſtence* together, or that we are compos'd of *Mind* and *Body.* So that theſe two things are no ways oppos'd to each other; to wit, that the Judgment concerning theſe things, follow the *Idea's* which we perceive by *ſenſe*, and is conformable to them; and yet the Nature of a thing *Thinking*, is altogether diſtinct from the *Nature* of a thing *Extended.*

V. *Mind differs more from Body, than from Nothing.*

For the *Idea* of the *Mind*, hath nothing common with the *Idea* of the *Body*, and one of them may be clearly and diſtinctly conceiv'd without the other. Nay, ſo great is the difference between *Cogitation* and *Extenſion*, that *Cogitation* may more properly be ſaid to be *Nothing*, than *Extended*; becauſe tho' in reſpect of *Subſtance* generally ſo taken, *Mind* differs not more from *Body*, than from *Nothing*, ſince both of them is ſomething ſubſiſtent, and wants not the help of another *Subſtance* to *Exiſt*; yet if they be conſider'd in themſelves, ſo far as one of them is *Extenſe*, and the other *Cogitant*, they are more diſtinguiſh'd from each other, than from *Nothing*; in regard every *Creature*, being not a moſt perfect *Entity*, but including many *Imperfections*, participates of Nothing. But it can be no way apprehended, that the *Idea* of *Cogitation* ſhould include any thing of the *Idea* of *Extenſion*, and conſequently *Cogitation* diſagrees or differs more from *Extenſion*, than from *Nothing.* In the ſame manner as *Vertue* is more properly diſtinguiſh'd from *Vice*, than from *Stupidity*: And *Science* is more remote from *Errour*, than from *Ignorance.*

VI. *It is prov'd that the Soul is Immaterial.*

This diſtinction being well underſtood, it will be no difficult thing to make out, that the *Mind* is a *Spirit*, or ſome *Immaterial Entity*; becauſe ſince *Mind* and *Body* are Subjects of different Proprieties, the *Conceptions* which we have of them, are alſo abſolutely different. For the diverſity of *Eſſences* is known to us by their Proprieties. Nor have we any other Indication whereby to judge, that the *Natures* of things are different, than by inſpecting into the diſtinction of *Proprieties* in them. For we have no other way to make obſervation, that *Ice* and *Fire* differ from each other; but becauſe *Fire* heats, and *Ice* cools; or that the *Eye* is a thing different from the *Foot*; but becauſe we ſee with our *Eyes*, and diſtinguiſh divers *Objects*, and with our *Feet* we walk and ſuſtain our *Body.* Since therefore *Human Mind* and *Body* have altogether different Proprieties, no *Man* can doubt, but that there is an abſolute diſtinction between them; and I dare ſay, there are no *Attributes* which are more oppoſite one to another, than to *Think* and to be *Extended.* For to be *Corporeal*, and to *Know*, what relation have they one to the other? What Similitude can be apprehended between *Perception* and *Motion*? or between *Will* and *Figure*? Whence it is plainly to be aſſerted, that *Mind* and *Body* are altogether different; and conſequently ſince *Body* hath *Extenſion*, the Thing *thinking* muſt needs be void of all *Extenſion*; which is the ſame thing as to be *Immaterial:* For by the Name of an *Immaterial Entity* nothing elſe is to be underſtood, but that which hath no parts, and is void of *Extenſion.*

VII. *An Objection drawn from the diſtinction of Juſtice and Mercy in God.*

If it be Objected, that diverſity of *Conceptions* does not always infer a difference in things; ſo as that they muſt be incompatible in the ſame *Subject.* For the *Conception* we have of *Juſtice* is undoubtedly diſtinct from that we have of *Mercy* in *GOD*; and yet no *Divine* can deny, but that they are both equally fit to be aſcrib'd to *GOD* himſelf; therefore it follows not, becauſe the *Conception* of the Thing *thinking*, is diſtinguiſh'd from the Conception of the Thing *Extended*; but that they may be attributed to one and the ſame *Subject.*

VIII. *An Anſwer to the Objection.*

I Anſwer, When two things may be conceiv'd incompleatly, or by abſtraction of the *Intellect* inadequately conceiving the *Matter*, there is no neceſſity that they be repos'd in divers *Subjects*; but thoſe may well be which are conſider'd *adequately*, or as *Compleat Entities:* For *Juſtice* and *Mercy* in *GOD* are conſider'd not as two Compleat Things, ſince *Juſtice* may be underſtood without a Juſt *Perſon*; but not *Mercy* without a Merciful *Perſon*: And conſequently ſince they cannot be but modally diſtinguiſh'd, they may be both in *One GOD.* But we compleatly underſtand, that a *Body* or *material Subſtance* is *Extenſe*, *Partible*, *Figurate*, with an Excluſion of all thoſe things which are peculiar to the *Mind*: And on the contrary we underſtand, that the *Mind* is a compleat *Subſtance*, which *Perceives*, *Wills*, *Doubts*, *&c.* tho' thoſe things be remote from it which belong to the *Nature* of *Body*; and ſo *Cogitation* and *Extenſion* are incompatible in the ſame *Subject.*

IX. *A thing Cogitant, and a thing Extenſe, are conceiv'd in another manner, than Figure and Motion in the ſame Subject.*

Other Objections which may be made againſt the Incompatibility of *Cogitation* and *Extenſion*, are reſolv'd in the ſame manner, as if any ſhould ſay, that *motion* and *figure*, and the like *modes* of a *thing Extended*, have divers *Conceptions*, and yet are found in the ſame *Subject.* For *figure* and *motion* cannot be conceived, but in *Extended matter*; For as *motion* is a *Body* having *figure*, ſo we cannot underſtand *figure*, but in Matter apt for *motion.* There is a great difference between *Motion* and *Figure*, and between a thing *extended* and *cogitant*; for ſhould all Moveable be taken away, we ſhould have no longer any *Idea* of *Figure* or *Motion* remaining, ſince ſuch is the Reaſon of *Mode*, that altho' *Subſtances* may be conceived without *Modes*, yet *Modes* cannot without *Subſtances*; therefore in regard we might conceive a thing *Cogitant*, tho' there were no ſuch thing as *Body* in

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rerum Naturâ; it follows, that a thing *Cogitant* is really distinguish'd from a *Subject Extense*, and consequently is *Material* and *Spiritual*.

X. *The Spirituality of the Soul is demonstrated by its Operations.*

The same Conclusion may also be demonstrated *à posteriori*, to wit, by its *Operations*, which are *Spiritual*, and absolutely Independent of all *Matter*: For *Volition* and *Intellect* include no *Extension*, since we conceive both very well, without any mention made of *Matter*. Besides, we find by daily Experience, that the *Cogitations* of *Man* are render'd the more obscure, by how much the more he hath of commerce with the *Body*; and on the contrary, more subtil and distinct, by how much the more he subtracts himself from the *Body*, as is manifest in *Extasie* and *Rapture*, where the *Mind* in a manner abstracted Meditates altogether on what is *sublime*, and distinctly sees all things; all which would never happen, if the *Soul* were *Material*. For if the *Power*, for Examples sake, of *Understanding*, depended upon the *Body*, it would of necessity follow its *Dispositions*, that is, be depress'd when that is weakned, and become more vivacious, when that is vigorous and strong. Whereas we find by Experience the contrary thereof in *Old men*, who apprehend things more clearly and distinctly than *Young men*, who at the same time excell *Old men* in *Strength* of *Body*, and have their *Animal Spirits* more vivacious, upon which *Corporeal motions* depend.

XI. *The Apprehension of Spiritual things, shews the Mind to be Incorporeal.*

Then how can it be, if *Human Mind* be *Material* and *Corporeal*, that it should contain in it self such vast *Images* of things? How should it comprehend the *Latitude* of the *Earth*, the *Immensity* of the *Heavens*, and the *Bodies* that are diffus'd through all parts of the *Universe*, if it be not *Spiritual*? How can it discern a *Line* to be altogether void of *Latitude*? A *Point* not discernable to the *Eye*, and wholly Individual? Wherefore we must in this Matter conclude with the Words of St. *AUGUSTINE*, *If Corporeal things are beheld with Corporeal Eyes, by a certain wonderful Affinity, it certainly follows that the Mind, by which we see Incorporeal things, is not Corporeal or Body.*

XII. *The Cognition of Verity, &c. argues the Immateriality of the Soul.*

Moreover, who knows not how many and how great things totally separate from all Matter our *Soul* can conceive? For without any help of the *Senses*, it apprehends *Verity*, *Sapience*, *Unity*, *Beauty*; it understands the *Principles* of *Sciences*, and unfolds the Demonstrations drawn from them, and attends to the *Series* of *Reasons*; but with what *Sense*, or with what *Corporeal Species* doth it represent these things to it self? Wherefore since by *Reason* alone it performs all these things, it must of necessity be *Immaterial* and *Incorporeal*. Lastly, Many things which are divided in themselves, meet together in our *Mind*, as *opposite* and *contradictory Propositions*, *&c.* yet nevertheless the *Soul* is not increas'd by the reception, nor by the withdrawing of them. A thing which cannot happen to *Body*, which always become greater by the addition of *Parts*, and lesser by the abstraction of them.

CHAP. III.

How Human Mind is United to the Body.

I. *Three Notions which usually present themselves to us.*

THere are Three principal *Notions* which commonly offer themselves to us: The *Notion* of *Body*, which we have maintain'd, consists in *Extension*, from whence the *Idea's* of *Figure* and *Motion* proceed: The Notion of *Mind*, whose Essence we place in *Cogitation*, and to which the perceptions of *Intellect*, and propensions of *Will* do tend: The third Notion is of *Soul* and *Body*, as they are united; from which *Union* we understand, that *Mind* hath the force of *moving Body*, and on the contrary, the *Body* hath the power of *Acting* upon the *Mind*, as shall hereafter be more clearly made out: For it is not to be imagin'd, that the *Soul* is only present with the *Body*, as a *Mariner* is present in his *Ship*, or as a *Rider* is seated upon his *Horse*; but that it is intimately united to it, so as to make one Compound with it: I say, the Notion of *Soul* and *Body*; because the *Soul* is properly so called, inasmuch as it is destin'd to *Inform* the *Body*, or inasmuch as it can be United to a well-disposed *Body*, as hath been formerly mention'd.

II. *Human Mind is to be consider'd, as United to the Body.*

For the *Soul* of *Man* is not to be consider'd as a *Spirit* in it self, and as it is Absolute and a *Substance* which *Thinks*; but according to the Relation which a *Spirit* hath to a *Body* well dispos'd, and to which it is United. For Experience plainly teacheth us, That all the Functions of the *Soul*, consider'd in Quality of a *Soul*, depend absolutely on the *Body*, to which it is United, and which renders this *Union* altogether necessary.

III. *It is difficult to conceive, how the Soul is United to the Body.*

The only difficulty is to apprehend this sort of *Union*: For our *Intellect* can hardly conceive, how *Body*, which is a thing *Extense*, moves the *Mind*; and *Mind*, which is a thing *Immaterial* and *Inextense*, can impel the *Body*; and tho' by Experience we find it is so, yet no Comparison or Discourse drawn from other things is sufficient to demonstrate and evidence it to us. Those *Philosophers* who admit *Real Accidents*, and judge that they are *Entities* distinct from *Substance*, produce a Similitude of a *Stone* tending downward, by the force of *Gravity*. Now since, according to these *Philosophers*, this Quality of *Grave things* tending downwards, is not *Substance*, but *Accident*, this may serve for a sufficient *Explication*, how a thing not *Extended*, may act upon a *Body* Extended.

IV. *To this difficulty the Prejudices of Infancy, and the Opinions of a School conduce.*

Yet because we maintain, that there is no such *Quality* in *Nature* granted, another way is to be found out; but before we fix upon a *Mode*, by which the *Body* is annex'd to the *Soul*, it will be worth our while to note, that all the difficulty in conceiving that *Union*, arises chiefly from our selves; who following the Prejudices of our *Infancy* first, and afterwards the trite Opinions of *Philosophy* in *Schools*, have thought it impossible for *Human Intellect* to conceive, how a thing *Material* and *Incorporeal* can be United, and how a thing *Unextended* can be associated to a thing *Extense*, unless that be taken also for *Extense*. This Prejudice hath exercis'd the *Wits* of many; and because they could find no Mode of *Union*, by which things so distant in *Nature* could be United, were compelled to have recourse to certain *Virtual parts*; and to assert, that the *Soul* is not indeed really, but only virtually *Extense*, and that it hath *Virtual parts*, by means whereof it may the better be adjoyn'd to the *Body*, and so compose one Total with it.

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V. *It cannot be said, that the Soul is virtually Extenſe.*

But what they mean by theſe *Virtual parts*, I confeſs I do not in the leaſt underſtand, nor doth any *Notion* of them preſent it ſelf to me. Nor can it be conceived, that there are things *Virtually Extenſe*, unleſs thereby are underſtood *parts* without *parts*, that is, whereof one is placed beyond the other. But *parts* ſituate one beyond the other, are diſtinguiſh'd not *virtually*, but *really*, and may ſeparately *Exiſt*, and conſequently may be ſaid to be really diſtinguiſh'd; ſince in the Conception of them *Diviſion* is included, and a Separation of them one from another, which preſuppoſe *Extenſion*.

VI. *Three ſorts of Union.*

But that the Conjunction of *Mind* and *Body*, which is commonly call'd *Union* may be the better underſtood, we are to premiſe what *Union* is, and how many kinds of it there are. *Union is a Conſociation of things agreeable into One.* And ſince we can have a *Conception* but of two things, namely *Mind* and *Body*, we can thence infer only a Threefold *Union:* The firſt, which intercedes between two *Bodies*; the ſecond, by which two *Minds* are aſſociated; the third and laſt, by which *Mind* and *Body* are United. But all *Union* includes ſome Similitude and Dependency, in which reſpect 2 different things paſs after a certain manner into one. For in this very reſpect they are judged to be United, when they can *act* and ſuffer dependently upon each other: For 2 *Bodies* are ſaid to be United, when they are ſo near, that one may act upon the other; and that again ſuffer from the former. Not that it is neceſſary, that both together *act* and *ſuffer* at once; but it is ſufficient, if one *act* and the other *ſuffer*. In the ſame manner 2 *Minds* are united one with another, when the ſame *Affections* are common to them both, and are ſo diſpos'd, that neither of them *wills* or *loves* any thing, but for the others ſake. In the ſame manner we ſay, that a *Rational Soul* is joyn'd to the *Body*, when any *Operations* of the *Body* depend upon the *Cogitations* of the *Mind*; and on the contrary, that the *Body* is joyned to the *Soul*, when any *Cogitations* ariſe dependently from theſe *Operations*, or rather *motions* of the ſaid *Body*.

VII. *How Mind and Body are United.*

Nor do I think, that any one will deny this manner of *Conjunction* or *Union*, by which the *Mind* and *Body* are conjoyned, ſince a clearer cannot be made out; in regard the *Mind* and *Body* operating dependently upon each other, we may very eaſily underſtand the Similitude and Relation, which ought to be among things which are united; and this *Similitude* and *Relation* we have formerly affirm'd to conſiſt in *Action* and *Paſſion:* So that as the *Union* of 2 *Minds* will continue ſo long as *Love* remains between them; ſo the Union of 2 *Bodies* will never ceaſe, ſo long as they are locally preſent one with another. In like manner the *Union* of *Mind* and *Body* will not be diſſolv'd, ſo long as he who hath joyn'd them together ſhall ſuffer the *Body* to produce its *motions*, with a dependency upon the *Cogitations* of the *Mind*, and the *Mind* to Exerciſe its *Cogitations* dependently upon the *motions* of the *Body*.

VIII. *The Conjunction of the Mind with the Body, is twofold.*

By Two ways moſt eſpecially may *Spirit* be joyned with *Body*; firſt into one *Perſon*; as *the Word was made Fleſh*, S. John 1. Secondly, Into *One Nature*; as *Human Mind* is joyned with *Body*. Of the firſt, *Divines* treat in their *Theſes*, concerning the *Incarnation* of the *Word*; the ſecond is handled by *Philoſophers*.

IX. *Wherein conſiſts the Union of Soul and Body.*

The *Union* of *Soul* and *Body* conſiſts in an Actual dependency of all the *Cogitations* of the *Soul*, upon certain *motions* of the *Body*; and of ſome certain *motions* of the *Body*, upon ſome *Cogitations* of the *Soul*; I ſaid in the firſt place, That this *Union* conſiſts in an *Actual dependence*; becauſe for the *Uniting* of *Body* and *Soul*, it ſuffices not that their *Motions* and *Cogitations*, can mutually depend upon each other; but it is alſo neceſſary, that they Actually depend. In the ſecond place, I ſaid; and of *ſome certain motions of the Body, upon ſome Cogitations of the Mind*; becauſe not all the *motions* of the *Body* depend upon the *Cogitations* of the *Mind*, ſince many depend upon the Machin of the *Body* only, and the *Univerſal Laws* of *Nature*.

X. *There is not requir'd any Union, as a thing diſtinct from Mind and Body.*

Others explicate this Commerce another way; for they will have it, that a certain *Mode* intercedes between *Body* and *Mind*, to which they give the Name of *Union*, and account it inſtead of a Ligament or Bond, by which thoſe things that make up the Compound are joyned one with another. For they cannot conceive how 2 Things can be joyn'd together, and nothing of New happen upon this *Conjunction*. But they have enough to be ſatisfied: For if by the Name of *Union*, they underſtand nothing, but that mutual Commerce of *Actions* and *Paſſions*, which is found in *Mind* and *Body*, they agree with us; for we acknowledge that *Union* is the *Mode* of the Being of *Body* and *Soul:* For all things are after another *mode* or *ſtate* when United, than when Separated. But if they mean, that this *Union* is ſome real thing diſtinct from both, and as it were that very thing, by the *mediation* whereof the *parts* of a Compound are United, we apprehend not, nor acknowledge any ſuch thing in *Philoſophy*; and ſhould we receive it, we can no way make it out, how ſuch a thing can joyn together two ſuch, as *Mind* and *Body*. For this *Union* ſhould be either *Extenſe*, or void of all *Extenſion:* If they affirm it *Extenſe*, how can it be Co-extended with *Mind*, which is a *Spirit* and *Immaterial?* If it be void of *Extenſion*, how can it be joyn'd to a *Body?* So that this *Mode* of Uniting is altogether ſuperfluous, ſince the difficulty of Conceiving how 2 *Subſtances* can be immediately United one with another, by a mutual dependence of their *Motions* and *Cogitations* is leſs, than to comprehend, how they ſhould be united by another thing, which if it be *Inextenſe*, cannot be conjoyn'd to the *Body*; nor to Mind, if it have *Extenſion*, and be divided according to *parts*.

XI. *But a Reciprocation of Action and Paſſion.*

And the Truth is, ſince neither *Body* can *Think*, nor *Mind* be capable of *Dimenſion*; there can be no *Mode* common to *Mind* and *Body*, except a mutual Acting of each upon each, from which alone the Proprieties of both can follow.

XII. *Whether the Soul and Body be United to each other, before they mutually Act and Suffer.*

Perhaps it may be ſaid That the *Conjunction* of *Mind* and *Body* cannot conſiſt in the relation which the *Actions* and *Paſſions* of both have to each other; becauſe ſuch a Concourſe preſuppoſes, that the *Mind* is already United to the *Body*. For the *Mind* muſt firſt be in the *Body*, before it can draw forth any *Operations* which depend upon the *Body*, and conſequently *Union* precedes that *mutual dependency*.

XIII. *The Answer.* I Answer, That there is no Necessity that the *Mind* should be first United to the *Body*, before it operate there, in regard its *Existence* precedes not *Action* in Time: So that it does not absolutely require to be joyned to the *Body*, before such time as it draws forth its *Operations*. Nay, if the Matter were well Examin'd, when as *Spirit* is confin'd to no Space, and may only be in a place by its *Operations*: It cannot therefore be said, to be in the *Body*, but because it exercises there its *Operations* or *Cogitations* dependently on the *Body*. Which mutual Correspondence constitutes the Reason of the *Union*, which is between the *Mind* and *Body*.

XIV. *When the Union betwetn Mind and Body begins.* But if it be ask'd, How comes about this *Conjunction* of *Soul* and *Body*, and when doth it begin?

I Answer again, It is most Consentaneous to Reason, to believe that this *Union* begins at that very *moment* in which the *Body* gives occasion to the *Mind*, to draw forth some *Cogitation*, and Contrarily the *Soul* to the *Body*, to stir up some *motion*. For as this *Conjunction* is plac'd in a mutual *Dependency*, which is between both, in respect of certain *Actions* and *Passions*, it cannot begin sooner: So that it is most probable, that such a Union begins, as soon as the *Heart*, *Brain*, *Nerves*, *Muscles*, *&c.* are sufficiently fram'd to bring it about, that the *Action* of the *Objects* may be transmitted as far as the *Glandula* and the *Animal Spirits* be convey'd into the *Muscles*. On the contrary, this *Union* ceaseth, whenever it happens that the said Commerce cannot be continued, or when any part of the *Body* is so defective, that the *Heart* is no longer able to transfuse the *Spirits* to the *Brain*; nor the *Brain* into its *Muscles*, to agitate some, and conserve others in their proper state: So that the said Confederacy is never broken on the part of the *Mind*, but of the *Body*.

XV. *This Union is Essential to Man.* From these things we deduce, that the *Conjunction* of *Soul* and *Body*, though it be call'd an *Accident* of either part, so far as it may be present or absent, without the destruction of either part, is nevertheless so proper to both Parts of *Man* together, that it may and ought to be allow'd to be *Essential* to him: For *Essence*, as it is deriv'd from *Esse*, to *be*, is so called, because so long as it is something, it must of necessity *be*. So that so long as *Man* is, it follows, that the foresaid Efficacy of *Mind* upon *Body*, and of *Body* upon *Mind*, must needs *be*.

XVI. *Why GOD may not be said to be joyn'd to his Creatures, or an Angel to an assumed Body.* But it is also easie to Understand, why GOD, tho' he is present to all *Created things*, as who Conserves the same by a Continued *Creation*; yet nevertheless is not said to be conjoyned to them, in regard they cannot act upon GOD, by exciting in him those *Cogitations* which he had not before. So also an *Angel*, who according to the Vulgar Opinion, is present personally in an assumed *Body*, cannot be said to be joyned to the said *Body*. For tho' an *Angel* may act upon such a *Body*, yet that *Body* cannot Re-act upon the *Angel*; So as that when the said *Body*, for Examples sake, is hurt, the *Angel* should *feel pain*, as we find by Experience in our selves.

XVII. *Conditions of the Union of Body and Soul.* But as there is no Society, which is not founded upon some Conditions, which are Reciprocal between one and the other party, united or associated together: GOD, in the formation of *Man*, united *Body* and *Spirit* upon these Conditions.

XVIII. *The First Condition.* The *First* is, That as long as the *Soul* shall remain United to the *Body*, there will be an *Idea* of *Extension*, that is to say, of *Body*, consider'd in it self; and that it shall have this *Idea* from the *motion* of the *Brain*, excited by the general Course of the *Animal Spirits*; according to which condition, the *Soul* hath always present the *Idea* of *Extension*, as Experience teacheth us.

XIX. *The Second.* The *Second* is, That the whole *motion* of the *Brain*, which is excited by the *Nerves*, will produce within the *Soul* a certain *Sensation*, which will always accompany this *motion*, and the *Soul* not be able to separate it. By means of this *Condition*, we *see*, for Example, the *Light*, when the *Sun* moves the *Optick Nerves*: We *hear* Noise, when resounding *Bodies* shake the *Auditive Nerves*.

XX. *The Third.* The *Third*, That the *Spirit*, so long as it remains United to the *Body*, will have the *Idea* of some particular *Body*, from the *motion* which this *Body* shall excite in the *Brain*, by the means of the *Organs* of *Sense*. By this Condition, the *Soul* hath the *Idea* of all *Bodies*, which smite the *Senses*.

XXI. *The Fourth.* The *Fourth*, That the whole *motion* of the *Brain*, which shall be excited by the determinate Course of the *Animal Spirits*, resembling another *motion*, caused by the *Nerves*, will produce in the *Soul* the *Idea* of some particular *Body*, which the *Soul* hath already perceiv'd. By this *Condition* it is, that there are represented to us things absent, which we have formerly seen.

XXII. *The Fifth.* The *Fifth* is, That by the *Sense* of *Touching* we feel *pleasure* or *pain*, according as the *movents*, which cause these *Sensations*, shall be conformable or in opposition to the Natural *Constitution* of the *Body*. By this Condition, the *motion* of a *Feather* drawn over the *Hand*, as it were for *Titillation*, will cause a Sentiment of *pain* in *Sick People*, in regard the said *motion* is not agreeable to the present state of the *Body*. On the contrary, it excites a Sentiment of *pleasure* to those that are in *health*, because in that Estate it is conformable to the present Constitution of the *Body*.

XXIII. *The Sixth.* The *Sixth* is, That when we have received the *Idea* of an *Object*, it will be attended by an Inclination of the *Soul*, which will carry it either to *fly* or to *pursue* the said *Object*, according as it shall appear *good* or *bad*. By this Condition it is that we are sensible of *Love*, *Hatred*, and generally all *Passions* that attend the *Soul*.

XXIV. *The Seventh.* The *Seventh* is, That all the *Thoughts* of the *Soul*, which regard the *preservation* of the *Body*, as they create *Sentiments* and *Passions*, must be accompanied with that *motion* of the *Animal Spirits*, which shall be most proper for the Execution of the *Desires* of the *Soul*. And it is upon this Condition that *Fear*, for Example, is accompanied with a Course of *Animal Spirits*, which induceth us to shun what we *fear*; and that on the contrary, *Desire* is accompanied with a Course of *Spirits*, which carries us to the pursuit of that which we *desire*.

XXV. *The Eighth.* The *Eighth* is, That the *Spirit*, inasmuch as it is united with the *Body*, never *Thinks*, but by the *motions* of the *Body*, to which it is united. And it is by this *Condition*, that all the *Idea's* which we have

have of particular *Bodies*, depend mediately or immediately, upon some *motion* of the *Brain*. I say, *All the Idea's we have of particular Bodies*: And hereby we are to Note, that the *Idea's* which the *Spirit* hath of *GOD*, and of it *self*, depend not at all upon its *being* United with the *Body*; but simply upon its being a *Spirit*, whose whole *Nature* is to *Think*, and by consequence to *think* of *GOD* and of it self.

XXVI. *The Ninth.* The *Ninth* is, that when the *Animal Spirits* are more abounding than usual, they excite in the *Soul*, *Goodness* and *Liberality*; when their Parts are more strong and gross, they excite *Confidence* and *Hardiness*; when they are equal in *force*, in *grossness* and in *figure*, they procure *Constancy*; when they are more agitated, they produce *promptitude*, *diligence*, and *desire*. In fine, when they have a temperate *agitation*, they cause *tranquility* of *Spirit*. On the contrary, when these *Qualities* fail in the *Animal Spirits*, or when there is an opposite Temper in them, the effects that are produc'd in the *Soul*, are *Malignity*, *Timidity*, or *Fearfulness*; *Inconstancy*, *Tardiness*, *Inquietude*, *&c.*

XXVII. *The Tenth.* The *Tenth* and last *Condition* is, That the Union of *Spirit* and *Body* will continue so long as the *Heart* shall be in a condition to send *Blood* towards the *Brain*, and from thence to send the *Animal Spirits* through the *Nerves* into the *Muscles*, which are subservient to those *motions* that are necessary for *Life*. By this Condition it is, that the *Soul* never gives occasion to the *Body* to break the *Union*, it being sufficiently evident that the default always proceeds from the *Body*, as Experience teaches us.

CHAP. IV.

Whether there are Innate or Inbred Idea's in Human Mind.

I. *There are three sorts of Idea's.* IT is a frequent and common Disquisition in the *Schools*, whether *Human Mind* be *pure Potentia*, or *Power*, and so abstracted from the *Species* or *Idea* of things, as to have no inbred *Cogitations* in it. The *Aristotelians* maintain the Affirmative, and are of *Opinion*, that that Faculty of *Perception* which we experiment in our selves, is, when first the *Mind* begins to exist, as it were a *Rasa Tabula*, or *plain Table*: So that whatsoever *Idea*, in process of time, is deprehended in it, is drawn from the *Senses*, or acquir'd by *Tradition*. So that for the better Solution of this famous *Question*, we are first to know what an *Idea* is, and how many Acceptations it admits of. By the Name of *Idea*, nothing else is understood, but *the thing it self thought, so far as it hath any thing Objective in the Intellect*. Or more in short, *Whatsoever can be conversant in our Cogitation*: And there are Three kinds of it, namely, *Adventitious*; or those which are receiv'd from things transmitted by the *Senses*; as is that *Idea* which we have of the *Sun*, *Stars*, and the like *External Objects*. Secondly, *Fictitious*, or which are formed from our *Intellect*; as the *Idea's* we have of a *Chimæra*, *Syrens*, *&c.* Lastly, *Innate*, which are Created with the Faculty of *Thinking* and forming them: And they are called *Innate*, in the same manner as we speak of the *Stone*, or the *Gout*, to be Natural to some *Families*, of which *Families* they who are born, bring with them into the *World* a disposition prone to those *Diseases*.

II. *The Idea's of Qualities are Congenite or Equally born with the Soul it self.* These things thus briefly noted, we are next to enquire, Whether *Human Mind* be so Created, as to have these sort of inbred *Idea's* born with it, and not drawn from any of the *Senses*; and in Truth, it seems not to be deny'd, but that many such *Idea's* are found therein. For to begin from things most obvious, it is most certain, that the *Idea's* which we perceive by any *sense*, are *inbred*, and can no way proceed from the Things themselves by any *Similitude*. For he that well understands, by what way the perception of *Pain*, for Example, is excited in the *Soul*, will easily be convinc'd, that the *Idea* of *Pain* hath no more affinity with that perverse *disposition* of *Parts*, by whose means the *Soul* frames an *Idea* of *Pain*, than that deprav'd *Affection* hath an affinity with a *Sword*, by which a *Wound* hath been inflicted into a *Body*; or than the unwonted agitation of *Blood* or *Spirits*, by whose impulse *Human Mind* conceives *Idea's* of *Passions*, carries a Similitude with those *Images* or *Cogitations*; and consequently when the *Sense* of *Pain*, and other Perceptions which are produc'd by the *motions* of the *Spirits*, are excited in the *Minds* by no other *Species*, which have affinity with them, it must needs be affirm'd, that these sort of *Idea's* which have no affinity, are innate or inbred to it. For it is evident, that all the *Perceptions* of the *Senses* are obscure and confus'd, insomuch that *Light*, *Colours*, *Sounds*, *Odours*, *Sapours*, *Heat* and *Cold*, and other tactile *Qualities*, are not apprehended by us, but by a confus'd way, and not under the Conception of *Motion*: And hereupon we must conclude, that their *Idea's* are innate in us, and that it is from our *Nature* that we understand them.

III. *The Idea's of Mathematical Figures, are implanted into the Mind, from their first Original* This takes place not only in *Qualities*, whereof we acknowledge our *Cogitation* to be confus'd; but also in things most clear and manifest. For what can be more clear, than that when a *Line*, a *Triangle*, a *Rhombus*, or other *Mathematical Figures* are given, it is not to be attributed to our *Senses*, that we have the *Idea's* of them? Since most certain it is that there is no absolute true *Right Line* in Nature, nor any *Triangle* whose 3 *Angles* are perfectly Equal to two Right *Angles*. Since therefore the *Idea's* of *Figures* proceed not from the *Senses*, and contain nothing *Corporeal* or of *Corporeal Affection*, we must necessarily conclude, that they are implanted in *Human Mind*; that is, that a Faculty is given by *GOD* to the said *Mind*, to produce such like Forms of *Conceptions*, and that they are not form'd according to any Exemplar of things without.

IV. *It is a false Maxim, that there is nothing in the Intellect, which was not first in the Senses* If any one Object, That trite Saying of the ARISTOTELIANS in the *Schools*, *viz.* that *there is nothing in the Intellect, which was not first in the Senses*. I answer, that that *Vulgar Axiom* is altogether false, and only to be admitted by those who do not sufficiently consider by what *Motives* the *Soul* is excited to perceive *External things*. For whoever will seriously examin, how far our *Senses* extend themselves, and what it is precisely that can arrive from them to our Faculty of *Thinking*, must needs grant, that no *Idea's* of things are presented from them to us, such as we form them

them in our *thought*; so that there is nothing in our *Idea's* which was not first inbred in our *Mind* or *Cogitant Faculty*, excepting those *circumstances* which regard experience, so as to *judge*, that such or such *Idea's* as are now present to our *Cogitation*, are to be referred to things without us: not that the said *Idea's* have immitted those very things to our *Mind* through the *Organs* of our *Senses*, but because they have immitted something which gave it occasion to form those very things by a faculty innate to it, at one time rather than another; forasmuch as nothing hath access to our *Mind* from *external Objects*, through the *Organs* of our *Senses*, except certain *Corporeal Motions*; but neither those *Motions*, nor the *Figures* arising from them, are conceived by us, such as they are form'd in the *Organs* of the *Senses*; whence it follows that those very *Idea's* of *Motions* and *Figures* are inbred in us. And so much the more ought the *Idea's* of *Pain*, *Colours*, *Sounds*, and the like, to be *innate*, as our *Mind*, by means of certain *Corporeal Motions*, can exhibit them to us; since they have no similitude with *Corporeal Motions*.

V. *It is by Nature that we understand what is Thing, Substance and other general Axioms.*

Besides, who can have the confidence to assert, that the *Idea's* we have of *Thing*, *Substance*, *Truth*, *Goodness*, *Equity*, and the like general Natures, have any commerce with *Material Things*, and that the *Idea's*, which we form of them, flow'd out of *Bodies*, through the *Senses*, into the *Mind*? Who will be so positive as to affirm that these Common *Notions*, for Examples sake, *The same thing cannot be and not be*; *that which is done cannot be undone*; *those things which agree in a third, agree among themselves*; *take equals from equals, and there remain equals*; and the like, proceed from the *Senses* and from *things* without us? What can be more absurd, than that all common *Notions*, which are in our *Mind*, arise from the said *Motions*, and cannot be without them? I would fain have any one tell me, what that *Corporeal Motion* should be, which can form any common *Notion* in our *Mind*; since all those *motions* are particular; but these *Notions* are universal, and have no affinity or relation to the said *motions*. Since therefore nothing can come into our *Mind* from *Bodies* but by *motion*; it is not to be doubted, but that those *Idea's*, at least, which have no affinity with *motion*; are *Congenite* and Inbred with the said *Mind*, from their *Original*. Hence St. *Augustin* in his 9*th* Book *de Trinitate*, *The Mind*, saith he, *knows it self by it self*; and in another place, *It is known for a certain, that the Mind can never be so affected, as not to remember, not to understand and love it self, though it should not be always thinking*.

VI. *The Idea of God is inbred in Human Mind.*

The same thing also evidently appears in that *Idea* which *Human Mind* hath of the *Existence* of *GOD*; forasmuch as it forms the said *Idea*, not by the Benefit of the *Senses*; not by *Human Institution*; not by its own Arbitrement: And consequently it must needs be innate or inbred in it, since there is nothing else in *Nature* to be found, which can set set forth an *Ens Infinite*, *Omnipotent*, *Immense*, Supreamly *Good* and *Perfect*; for though there is in us, in regard we are *Substances*, an *Idea* of *Substance*; yet there occurs not to us from thence an *Idea* of a Substance, *Infinite*, *Independent* and *Supreamly Intelligent*, &c. since we are finite; and so, whatever *Idea* we have of *GOD*, must needs have it from a *Substance* which is Infinite, that is, *GOD*, and consequently which immediately proceeds from him.

VII. *Whether an Idea of God can be had from the Observations of things.*

If it be urg'd, that this *Idea* of *GOD* which we experiment in us, proceeds not from our faculty of *thinking*, to which it is innate, but from *Divine Revelation*, *Tradition* or *Observation* of things; for in an *Entity* supreamly perfect, which is call'd *GOD*, *Human Mind* considers nothing but those *perfections* which are found in *Man*; for Examples sake, *Existence*, *Power*, *Justice*, *Mercy*, and the like: from which, if imperfection be removed, they may be so ascribed to *GOD*, the most Excellent of *Beings*.

VIII. *The Difficulty remov'd.*

This *Objection* is resolved by our most illustrious *Philosopher*, in his Answer to the *fam'd* REGIUS, *Physician* of *Utrecht*; by giving to understand, that one *thing* may *be* from another two ways; either because this other thing is the *proximate* and *primary Cause* thereof, or because it is *remote*, and only *accidental*, and so gives occasion to the *Primary Cause* to produce its effect at one time rather than another: As all *Artificers* and *Workmen* are the *primary* and *proximate Causes* of their own *Operations*; but they who set them on *work*, and pay them for their *labour*, are the *accidentary* and *remote Causes* of the said *performances*, which perhaps, the *Workmen* unbidden, and without hopes of reward, would scarce have gone about. Now there is no doubt but Tradition, or the Observation of things is often times the remote *Cause* which inviteth us to give attention to that *Idea* which we are able to conceive of *GOD*; and to represent it to our *Cogitation*. But that it is the *proximate* and *efficient Cause* of the said *Idea*, cannot be asserted by any one, except by him who judges that nothing is ever understood by us concerning *GOD*, but what the name *DEUS* or *GOD* means, or what sort of *Corporeal Figure* it is, which is made use of by *Painters* to represent *GOD*. Forasmuch as Observation, if it be made by the *Sight*, represents nothing to the *Mind* by its own proper vertue, but *Pictures*, and those only consisting of certain *Corporeal Motions*; if by *hearing*, nothing but *Words* and *Voices*; if by other *Senses*, nothing is contain'd in the said *Observation* which can possibly relate to *GOD*: So that all those things we think of, except *Voices* and *Pictures*, as their *significates*, are represented to us by *Idea's*, not coming from elsewhere than from our faculty of *thinking*, and consequently inbred in us.

CHAP. V.

Of the Faculties of Human Mind, Intellect, Imagination, Will, Memory, Reminiscence and Wit.

I. *Diversity of Actions argues diversity of Powers.*

SINCE there are found various *Operations* in the *Mind*, we must of necessity assign various *Principles* from whence they proceed; for diversity of *Actions* argues diversity of *Powers*. Wherefore since there are divers *Species* of *Cogitations* in the *Mind*, there are consequently to be established divers *faculties* which are the proprieties of a *thinking* Being. Forasmuch as by the word *Faculty*, nothing else is understood, in *Human Mind*,

VII. Whether an Idea of God can be had from the Observations of things.

VIII. The Difficulty remov'd.

To the Right Honourable Botterwick, Earle of to King Iames ye 2d, Lord Rideing of Yorkshire, vice Northumberland, and of the most noble order Mats. most Honourable This Plate is humbly

SOLI QVI MALE CVRANSE HONI

PRESTO

Iohn Sheffeild, Baron of Mulgrave, Ld. Chamberlaine Lievtenant of the East= Admirall of Yorkshire Bishoprick of Durham, Kt. of the Garter, & one of his Privy Councell &ca Dedicated by Richard Blome.

Mind, but an Aptitude or Capacity to a certain Variation; for ſince *Mind* is Indefinitely Variable, Actual Variety muſt needs proceed from ſome *Faculty*, as from a preſent *Cauſe*. All *Operations* which carry *Cogitation* with them, are of two ſorts. Of the firſt kind are thoſe *Operations* which have *Intellect* for their Principle. Of the ſecond are thoſe which depend upon *Will*. And tho' many other *modes* of *thinking* may be reckoned, yet they all proceed from two *faculties* of *Perceiving* and *Willing*: For *Senſe*, *Imagination*, *Itellect*, *Memory*, &c. are various *modes* of *perceiving*, whereas *Judgment*, *Affirmation*, *Negation*, and all our *Appetites* and *Propenſions* are different *modes* of *Willing*. Of the *Senſes* we have already diſcourſt; it remains that we ſay ſomething of *Intellect*, *Imagination*, *Will* and *Memory*.

II. *What Intellect is.* By the word *Intellect*, nothing elſe is to be underſtood, but that faculty by which the *Mind*, without any *Material Species*, apprehends all *Objects* whatſoever, whether *Immaterial* or *Corporeal*; and this faculty is more inſeparable from the *Mind* than any of the reſt; whereof there is not any one that hath not ſome dependence upon the *Body*; whereas the *Mind* hath no need of the help of any other thing to underſtand by, but it ſelf and its own proper *Idea's*. So that the *Mind* hath no need of any *Organs*, nor makes any uſe of the *Brain*, whereby to *Conceive* or *Underſtand External things*.

III. *How it is diſtinguiſht from Imagination.* Only in this one thing, *Intellect* is diſtinguiſht from *Imagination*, that is, that the *Mind* can Imagin nothing but *Corporeal*, when in Imagining it applies it ſelf to the *Body*, and contemplates the *Image* of the *Object* as preſent to the *Eye*, which happens not in *Intellection* or *underſtanding*; when as the *Mind*, in *Underſtanding*, is in a ſort recluded or ſhut up within its ſelf; and if it apply it ſelf to any *External Body*, it is only to contemplate the *Idea* of the Object which it hath in its ſelf. Wherefore that common Saying, *Nothing is in the Intellect, which was not firſt in the Senſe*, is not to be conceived of the pure faculty of *Underſtanding*. Since the pure *Intellection*, as we have ſaid, as well of a *Material* as *Immaterial Object*, is independent of any *Corporeal Species*, and cannot any way be received in the *Intellect*; but may very well be underſtood of the *Imagination*, becauſe we cannot poſſibly imagin any thing but what is *Corporeal*, particular and determinate. Whence the *Power* of *Imagining* in the *Soul* may be defin'd, *The Power which the* Soul *hath to know particular Bodies, and the repreſentations of Equality or Inequality which are in them.* So that *Intellect* and *Imagination* differ in reſpect of the *Object*; ſince the *Object* of the *Intellect* is of larger extent than the Object of *Imagination*, as having a perception, not only of things which belong to *Intelligences*, and *Subſtances* meerly *Spiritual*; but alſo many other *proprieties*, or particular *Bodies*, which are not deprehended from the *Senſes*, and which decline even *Imagination* it ſelf, as hath been ſaid in the foregoing *Chapter*.

IV. *The definition of Intellect.* Whence we may conclude, that *Intellect in general is nothing but a Faculty or Power which the Soul hath to know whatſoever it knows, by what way or manner ſoever it knows it.*

The ſecond ſort of our *Cogitations* proceeds from the *Will*, that is, from a *Power* within us, to determin our Reſolves, by *giving* or *denying* our *Aſſent* in things which are propounded by the *Intellect*. For ſuch is the form in the ordering of our *Cogitations*, that the *Light* of our *Underſtanding*, always precedes the *Actions* of our *Will*; in regard the *Intellect* is, as it were, the *Torch*, without which our *Will* cannot determin any thing. When, I ſay, that *Will* cannot determin any thing, but what the *Intellect* ſhews it; it is not to be ſo taken, as if thoſe two *Powers* were things diſtinct from each other, but that it is one and the ſame *Mind* which is diverſly conſidered according as it *Perceives* or *Wills*, and according as it *Suffers* or *Acts*; ſo as that *Knowledge*, *Pleaſure* and all other *Faculties* of the *Soul*, are but one and the ſame *Soul*, conſidered as having power to *Know*, to *Will*, to *Imagin*, to *Perceive*: For the *Intellect* is a *paſſive Power*, which conſiſts in this, that it wholly receives *Idea's*; whereas the *Will* is a faculty by which the Mind chooſes, or is determin'd to embrace or decline all that which the *Intellect* clearly perceives; ſo that the *Will* is nothing but the *free determination of the* Mind *to do any thing, or not to do the ſaid thing, to affirm or deny a thing to be ſuch or ſuch.*

V. *What Will is, and how it differs from Intellect.*

And conſequently *Will* in general may be defin'd, *a power which the Soul hath to determin and reſolve about thoſe things which it apprehends, which way ſoever it apprehends them.*

VI. *The definition of Will.*

For this is the *Nature* of *Will*, that at the ſame time wherein *True* or *Falſe*, *Good* or *Bad* is, by the *Intellect*, propos'd to it clearly and without confuſion, it reſolves, without any heſitation, to chooſe the one and reject the other; ſo that the *Eſſence* of it conſiſts not, as ſome will have it, in *Indifference* to chooſe any thing, or not to chooſe it, ſince *Will* can never be ſaid to be indifferent, except when the *Object* is not clearly and diſtinctly propos'd to it, or when it knows not what it ought to reſolve upon. For a *Man* is ſaid to be indifferent, when *few Reaſons* are propos'd to him, or *ſuch* as are not ſufficient to move him, to embrace one thing rather than another: whence it is ſaid of a *Sinner*, that always ſome things are found *indifferent* in him; namely, a *Sinner* knows not clearly the *Bad* he is about to commit; or if he formerly knew it, he attends not, at the time he commits it, to the *reaſons* which prove it to be *bad*; for if he perceiv'd it, it could not be that he ſhould *ſin*, according to that vulgar *Axiom*, *The Will purſues no Evil as it is Evil.*

VII. *The Eſſence of Will conſiſts not in Indifference.*

On the contrary, when a *man* ſees a thing clearly, and without all obſcurity to be convenient for him, it is almoſt impoſſible but that he ſhould be carried with an *inclination* to it, ſo long as the *judgment* of the ſelf ſame thing remains in the ſame *perſon*. So that *Will*, *infallibly* tends toward that which appears moſt convenient for it, ſo it be made clear and manifeſt to him. Nor is there leſs reaſon why it ſhould be called *Free*, ſince as DESCARTES ſaith, in his fourth *Meditation*, *Neither is it neceſſary that I ſhould be carried into both parts, to be free; but by how much the more I incline to one part, either becauſe I perceive* True *and* Good *more evidently in that, or becauſe* GOD *ſo inwardly diſpoſes my thought, ſo much the more freely I*

VIII. *But in Determination.*

chooſe that. Neither indeed doth *Divine Grace*, or *Natural Cognition* ever diminiſh Liberty, but rather increaſe and confirm it. But that *indifference* which I experiment, ſince no reaſon impells me to one part more than another, is the Loweſt degree of *Liberty*, and witneſſes no *perfection* therein, but only a defect, or a certain negation in *Cognition*. For if I could always ſee what is *True* and *Good*, I ſhould never make any doubt, what is to be judged of it, or choſen out of it; ſo though I might be abſolutely free, yet never indifferent.

IX. *Memory, and in what it conſiſts.*

By the name of *Memory*, ſo far as can be collected from the deſcriptions of other *faculties*, is underſtood the *Power which the Soul hath to conceive, feel or imagin, that which it hath already conceiv'd, felt or imagin'd*: And on the part of the *Body*, a certain facility which the *Pores* of the *Ventricles* of the *Brain*, which had before been relaxt by the *Animal Spirits*, have to open themſelves again. For if we conſider the Nature of thoſe *Species* which are preſerv'd in the *Memory*, we ſhall find that they are nothing but certain *Veſtigia* or *Footſteps* which the *Agitation and Courſe of the Spirits leave among the Fibres of the Brain*, almoſt in the ſame manner, as *folds* in a complicated *leaf* of *Paper* retain a faculty of entertaining again thoſe *forms* which had been before impreſt upon them; in regard that when the *Spirits* have a power of dilating the *Pores* of the *Brain*, of pleating, and variouſly diſpoſing of the *Filaments*, through which they paſs, according to the various *motions* in which they are carried, it comes to paſs that the *Pores* have a certain power of drawing and directing the *Spirits*, ſo that at length they paſs out through the ſame *intervals*, and in the ſame manner as formerly they went out; and ſo the ſaid *Spirits* finding out thoſe *Pores*, enter more eaſily into them than others; whence it happens that a *man* remembers any thing, when the ſaid thing, having been formerly obſerv'd by him, hath left certain *Veſtigia* in the *Brain*, by occaſion whereof the ſaid thing comes in mind.

X. *How we come to be able ſometimes to repeat a whole Oration.*

Whence no wonder, if, upon hearing a *Narration*, or reading an *Oration*, which we have committed to *memory*, we are able afterwards to repeat the ſame, and that in the ſame manner as we *heard* or *read* it; becauſe, as upon making of folds in *Paper*, the firſt fold being made, the reſt conſtituted in the ſame ſeries eaſily follow, as having regard to the ſaid *ſeries*. So that whatever *Veſtigium* is firſt made in the *Brain*, the reſt which have reſpect to that *ſeries*, eaſily follow.

XI. *How we come to remember thoſe things which we had forgot.*

In like manner we remember things which we have forgotten, when we recollect a certain diſtinct *Veſtigium* in the *Brain*, according as it occurs in the ſame *ſeries*; from whence beginning to deduce and unwind the *ſeries*, we proceed ſo far, till at length we diſcover that which, while hid, we enquir'd into. As in *Paper*, not meeting eaſily with ſome certain fold, we chooſe out ſome other diſtinct fold, occurring in the ſame *ſeries*, from whence a deduction being begun, the fold which they hid is at length diſcovered.

XII. *What things help Memory in the Brain.*

All *Species* which help the *Memory*, are eſpecially in the *Glandule* (which we have formerly declar'd to reſide in the midſt of the *Brain*) in regard that it is the principal *Seat* of the *Soul*; though other parts of the *Brain* are alſo ſometimes inſervient to *Memory*; nay, even the *Nerves likewiſe* and *Muſcles*, as is obſervable in a *Minſtrel* or *Muſitian*, who hath ſomething of *Memory* at his *Fingers* ends, ſince his dexterity in the moving of them, and ſhifting them up and down, which he hath acquir'd by long uſe, helps his *Memory* to the finding out of thoſe places, to the *ſmiting* whereof he is diſpoſed; and for the ſame reaſon the *Idea's* of two *things* occur in the *Mind*, if they were both impreſt together: For upon the beholding of any ones *Countenance*, immediately there occur, at one and the ſame time, *Eyes*, *Noſe*, *Forehead*, *Lips*, &c. in regard when we beheld his *Face*, all thoſe things appeared. Hence they who have once *taſted* of any *Meat*, wherein they have obſerved any thing that might hurt the *Eyes*, can never remember the ſaid *Meat*, but that alſo will occur, that it offended the Sight. Neither can they endure to *hear* any other perſon *ſpeaking* of ſuch ſort of *Meat*, but they will be affected with the ſame averſion; the cauſe whereof is, that the *Animal Spirits* excite the ſame *motion* in the *Glandule*, which they excited, when they firſt beheld the *Meat*.

XIII. *What Reminiſcence is, and what it adds above the Memory.*

Reminiſcence is an addition of ſomething above *Memory*; for it is not enough to *remember* that the *ſpecies* of a *thing* is ſimply objected, but it is alſo neceſſary, that when it occurs to us the ſecond time, we take notice, that it therefore ſo happens, becauſe it had been preſented to our view before; for indeed *Reminiſcence is nothing but the Reſumption, by preſent Memory, of Cognition firſt had, and then afterwards Obliterated*; and much of the like Nature is the inquiry and recovery of the *Knowlegde* of a *Man* whom we had forgot by reaſon of the preſent *memory* of *Places*, *Plays*, and the like; and conſequently there is required to *reminiſcence*, that the *Images* of things be partly obliterated, partly not: For we are then ſaid to *reminiſce*, when, from the Footſteps of the *Images* which remain, we recollect ſomething of thoſe which were ſlipt from our *Mind*. Wherefore the whole difference which is between *Memory* and *Reminiſcence*, conſiſts only in this, that to *Memory* it ſuffices, if any *ſpecies* return upon the *Glandule*, and that *ſpecies* be received without any reflection: But to *Reminiſcence*, beſides that reception of the thing, it is required, that the return thereof be known to us, and that we may have *knowledge*, that we had it, or perceived it before.

XIV. *Conſcience is included in all Knowledge.*

From what hath been ſaid, may be eaſily collected, that *Conſcience*, or *Self-knowledge* is involved in all *Human Knowledge*, and is inſeparable from it; for *Conſcience* is ſo manifeſt and intrinſecal to the *Mind*, that it cannot be abſtracted from it; but upon that very account, it may be affirmed to be deſtitute of *Senſe* and *Knowledge*, properly ſo called; for that which *acts* and *ſuffers*, and yet knows not that it *acts* or *ſuffers*, may be juſtly ſaid to want *ſenſe* in the ſaid *action* or *paſſion*; as is clearly demonſtrated in thoſe who being wholly intent upon any thing, or being moved with *anger*, perceive not; for examples ſake, the *ſound* of a *Bell*, or any thing preſented to the *ſight*, and conſequently neither are ſenſible of, nor acknowledge any of thoſe things. From whence it appears, that *Conſcience* is a certain *Species* of *Cogitation*, namely that immanent or inhering *action* of a *thinking ſubſtance*, by which it knows that

that it hath a real *Cognition* or perception of any thing. Forasmuch as *Conscience seems to be no other thing but the mind indued with knowledge, as well of it self, as of its own Cogitation*: whence CICERO in the 3*d*. Book of his *Offices*; *When*, saith he, *a Matter is to be propos'd to a person sworn, he is to remember that he hath* GOD *for a witness of what is said to him*; *that is to say, according to my Judgment, his own Mind.* Whence it follows that we are convinced by *Conscience*, as by a clear and distinct *Knowledge*.

XV. *Even in false Judgments.* Nor is it against our assertion, to say that the *Mind* is able to form various *judgments*, even tho' false, concerning its own *perception*, and *intellection*; because the *Mind* is never deceived in *this*, namely, that it should *know* or *understand*, at that time when it thinks that it *knows* and *comprehends*. In regard this *Perception* or *Cogitation* is always perfected by the *Mind* in the *Mind*, and therefore it cannot be, that when I *think* that I receive any thing with my *Ears*, I should not have such a *perception*; nay though it were possible, and should often happen that I should not *hear* at all, and the *Organ* of hearing should not be affected with any thing, so long that I think that it is affected; as we find it falls out in our *Dreams*: So that in all *Cognition*, two things chiefly are to be observed; the first is *Conscience*, which is that *Animadversion* whereby we mark, or take notice of any thing; the *other* is that which is said to be *Animadverted* or *observed*, and is all that which is immediately apprehended by the *Mind*, and which in the first and second part of this *Institution* we have often call'd *Idea*.

XVI. *What Wit is.* Now since the *Indowments* of *Wit* have also regard to the *Soul*, it may be here inquired, what *Wit* is, and whence so great a diversity of *Wits* arises, and why some *men* are more propense to certain *Studies*, and certain peculiar *managements* of *Life* than others. As to the first, some so describe *Wit*, as to call it a power implanted in *man* to *understand, act* and *govern* himself and others, to be approved in *Vertues*, or commit *Vices*; in all which generally one *man* very much excels another. In fine, *Wit* seems scarce to differ from *Ingenuity* or *Aptness*, and thereupon it may probably be said that it chiefly depends upon the *Organs* of the *Body*, and the disposition and contexture of the *Fibres*.

XVII. *Whence arises the Diversity of Wits* As to the second, concerning the *Variety* of *Wits*, It can by no means or possibility be imputed to the diversity of *Souls*; for in regard all *Souls* are *Intellectual* and *Incorporeal*, and own no *Author* but GOD alone, they seem, according to Nature, to be altogether equal, (unless GOD for some certain ends should design to produce some more perfect than others) and then all the inequality which is deprehended in them, must proceed from the variety of the *Organs*, and especially of the *Brain*: We understand not *human reason* pure and abstracted from the *Body*, but the same so far as it is perfected or hindred, in any manner, by the disposition of the *Body*.

XVIII. *What are the Indowments of Wit.* So *DES CARTES* in the begining of his *Dissertation*, concerning *the method of rightly using Reason*, reckons up three *qualities* of *Wit*; *Celerity of Thinking*, *Facility of distinctly Imagining*, *and Capacity and use of Memory*: Nor does he acknowledge, that he knows any other qualities different from these, by which *Wit* can be rendred more excellent. But *right Reason* or a *good Mind*, that is, *a Power of judging incorruptly and discerning true from false*, he* concludes to be equal in all, and distinguishes it from *Wit*.

XIX. *Celerity of Thinking depends upon the Spirits.* Now whence should the Celerity of *Thinking* proceed, but from the agility and promptitude of the *Spirits*? for we see *Men* frequently after a *chirping cup* of *Wine*, to become more chearful; and indued as it were, with a new faculty of *Thinking*; whence that trite Adage, with litle variation from *Horace*, Rich *Wines* make even *Fools Philosophers*. On the contrary, we see others of an acute *Understanding* and *Sagacity* of *Wit*, upon taking a *Cup* too much, or upon the *Brain* being ill affected, by never so small an indisposition, to become Heavy, Dull and Stupid, and very much unlike themselves, as to what they appear at other times, which certainly argues that the Celerity of *Thinking*, depends much upon the disposition of the *Body*, and that the inequality of the *Operations* proceeds from the inequality of the *Organs*.

XX. *The facility of distinctly Imagining, and capacity of Memory ariseth from the disposition of the Body.* In like manner the *Facility* of distinctly *Imagining*, and the capacity of *Memory* having regard to the internal *Sense*, are acquired chiefly by use, and rendred familiar by long habit and custom; whence we find by experience, that not all *Men* are carried with the like proclivity to certain kinds of *Studies*, but that as in some *Men* there is one sort of ingenuity, in others another: So there is a various promptitude to attain to *Sciences*; for they that are prevalent in *Imagination*, are very comprehensive of *Mathematical Demonstrations*, but have not happy success in *Metaphysical Speculations*; which happens not for want of *Ratiocination*; but because in *Mathematicks Imagination* only, not *Ratiocination* is made use of. So *DES CARTES Part* 2. *Epist.* 33. *That part of Wit, namely Imagination, which is chiefly conducible in Mathematicks, hurts more than profits in Metaphysical Speculations.* The diversity therefore of *Wits* ariseth from the constitution of the *Organs*, and from the temperament of the *Brain* and *Spirits*; which disposition, nevertheless, in regard it varies infinite ways; no wonder some *Genous's* are most inclined to *Philosophy*, others follow *Mathematicks*, others *Musick. &c.*

CHAP. VI.

Of the Affections or Passions of the Mind.

I. *That the Passions of the Soul are distinguisht from the Senses.* HAving treated apart of the *Nature* of the *Body* and *Soul*, and distinguisht the *Functions* of both, it remains that we say something of the *Passions* which are peculiar to *Man*, to whom nevertheless they are no otherwise Attributed, but as he consists of *Body* and *Soul*; for those *Affections* and *Operations* being neither belonging to the *Mind* alone, nor to the *Body* alone, proceed meerly from the Union and confederacy of *Mind* and *Body*; such as are the *Passions*, which are called *Affections* and *Commotions* of the *Mind*; because it is the *Mind*, which they principally shake and divers ways impel and disturb: For tho' the Senses depend also upon the said Union of *Body* and *Soul*, yet they gently insinuate themselves

selves into the *Mind*, and relate not so much to the *Soul* as to *External Objects*, by which also they may be deceived and drawn into an Error; but the *Affections* of the *Soul* are inward, and so adhere to it, that it cannot have experience of them any other way but as they are; whence it comes that they who are in a deep *Sleep*, seem to behold certain *things* with open *Eyes*, and to suffer those things in the *Body* which no way touch us: Yet nevertheless, it can be no way brought to pass, that we should feel our selves *sad or deeply in Love*, but that there must be really such a commotion in us, and that we are affected not with a *Feigned*, but *Genuin Love* or *Sadness*.

II. *The definition of Passion.* Wherefore the *Passions* of the *Soul* are thus best defined: The *Perceptions, or Senses, or commotions of the Soul, which are referr'd especially to it, and which are produc'd, conserved and corroborated by a certain motion of the Spirits.* They are first called *Perceptions*, because that name is common to all *Cogitations*; and we use it to signifie all *Cogitations*, which are produc'd without the Concourse of the *Will*, and which are excited by impressions left in the *Brain*; for whatsoever is not Action, ought to be called *Passion*.

III. *Each part of the definition explicated.* Next, they are called *Senses*, because they come to the *Soul* after the manner of *Senses*, and are of the number of those *Cognitions*, which by that streight bond that is between *Soul* and *Body* are rendred confused: But by a special term they are called *Commotions* of the *Soul*, in regard we are taught by our own experience; that no *Cogitations* enter into our *Soul*, which so much disturb and move it as those do. It is moreover added, that they are especially referr'd to the *Soul*, to distinguish them which come from exteriour *Objects*, or arise from interiour dispositions of the *Body*, as the preceptions of *Colours*, *Odours*, *Sounds*, *&c.* which are referred to *External Objects*; *Hunger*, *Thirst*, *Pain* which are referred to our *Body*.

IV. *Passions deriv'd upon the concourse of the Spirits.* Lastly, it is concluded that those *Passions are produc'd, Nourisht and Corroborated, by a certain peculiar motion of the Spirits*; to distinguish them from the proper *Acts* of our *Will*, which indeed may be called the commotions of the *Soul*, and also such as may be referr'd to the *Soul*, but which are not produc'd from the *Spirits*, but from the *Soul* it self. Whereas, in the *Passions* the *Animal Spirits* proceeding from the *Heart*, are carried into the *Brain*; and from their commotions ariseth the perturbation of the *Soul*, and being risen is conserv'd, so long as the *Animal Spirits* passing the same way, agitate the *Mind* by the same reason; and upon their increase, the commotion of the *Mind* may so increase as to be excited by them, not only to *judge*, but vehemently to *desire*, and sometime to grow *Mad*.

V. *How Human Passions are distinguisht from the Affections of a separate Soul or Angel.* Whence the *Passions* which are incident to *Man*, as he is composed of *Soul* and *Body*, are distinguisht from those which are belonging to a *Separate Soul*, or *Angel*; for there is no doubt, but that a *Soul* dislodg'd from the *Body* is toucht with various *Affections*, and is lyable to divers kinds of *Motions*: For seeing it hath a clear and distinct *knowledge* of *things*, it may also have *motions* attending the said *Cognition*; and so long as in those things it deprehends good or evil, it may refer them to it self, and consequently prosecute them with *Love* or *Hatred*: For if it obtain that good which it hath judged convenient for it self, there cannot but arise much *Joy* thereupon; but if it find it self deprived thereof, *Sadness* will follow: Yet those *Passions* differ from ours, because they are not joind with the *motions* of the *Animal Spirits*, which excite and conserve them in us. Nay, they arise in them by a clear and distinct *Cognition* which they have, of the thing which they look upon and behold as their good.

VI. *Affections are call'd Passions in respect of the Soul, Actions in respect of the Body.* But lest for the future any difficulty should arise about the word *Passions*, we assert that *Actions* and *Passions* in *Intellectual* and *Cogitative things*, are no other than what they are in *Corporeal things*; for as in a *Material thing*, *Action* and *Passion* consist in *Local motion*, being called *Action* when the *motion* is conceived to be in the *Movent*, and *Passion*, when it is considered to be in the thing *moved*; so in *Incorporeals*, *Action* is said to be, that which holds on the *Movers* side, as *Volition* in the *Soul*: *Passion* is that which keeps on the part of the thing *moved*, as *Intellection* and *Vision* in the same *Soul*. So the *Affections* which we take upon us here to describe, are called *Passions* in respect of the *Soul* to which they belong; but *Actions* in respect of the *Body*, which *Acts* immediately upon the *Soul*, and in its *Actings* effects mutation and variety.

VII. *Passions ought to move the Soul.* But because in *Man* there are found various *Passions*, and those *Passions* obtain several *Names*, according to the diversity of *Agents*: We say, those *Passions* are only considered by us, which proceed from some particular *Agitation* of the *Spirits*, and whose effects are as it were felt in the *Soul*; for tho' other *impressions*, which are formed in the *Brain* by *External Objects*; or which depend upon the Footsteps of former *impressions* left in the *Brain*; or which by the ordinary course of the *Animal Spirits*, are presented to us *Sleeping* or *Waking*, may be called *Passions*; that is, so far as they are excited in the *Soul* without the concurrence of the *Will*: Yet to speak properly, they are not so much to be called *Passions*, as *Habits*, or *Propensions* which dispose to some *Passion*, since they move not the *Soul*, nor depend, or are cherisht by any special course of the *Animal Spirits*.

VIII. *The various causes of Affections. First Temperament.* Although the *Agitation* of the *Spirits*, may be called the proximate cause of our *Affections*, yet there are other remoter causes, which may be assigned, as the *Temperament of our Body*, which conduces not a little to the exciting of *Passions* in the *Brain*; since it is in the stead of *Disposition*, and after a sort impells the *Soul* to follow its propensions: Hence, those who have their *Body* any way disposed to *Love*, easily suffer their *Minds* to be drawn away to those *Cogitations*, by which they are excited to the said effect.

IX. *The second cause of Passions is the Objects.* The second *Principle* is those *Objects*, which incur into our *Senses*; as any terrible *Figure* excites the *Passion* of *terrour* in the *Soul*; whereas a grateful *Figure* which courteth the *Eyes*, causeth *Joy* and *Benevolence*, in regard the *motions* convey'd from *External things* to the *Brain*, variously dispose the *Spirits* thereof, and thereupon there arise different *Affections* in us: So that who ever desires any thing of us with a smooth *Tongue*, down-cast *Eyes*, and a *Body* disposed to *Humility*, will more easily obtain his desire of us, than another

ther, who on the contrary, with a ſevere *Countenance*, an imperious *Tone* of *Voice*, and more like a Commander than a Suppliant demands the ſame.

X. *The third is the Action of the Soul.* The third *Cauſe*, is the *Action* of the *Soul* it ſelf, as often as according to its innate *Liberty*, it propoſes ſuch or ſuch *Objects* to be conſidered, in the long meditation where the *Paſſions* ariſe.

XI. *The fourth cauſe is the firſt diſpoſition of the Body.* The fourth *Cauſe* is, the firſt *Diſpoſition* of the *Body* in regard not only *Affections*; may be excited in us by *Rational motions* of the *Mind*, whileſt it knows what to proſecute with *Love* or *Hatred*; but alſo by thoſe firſt *Diſpoſitions* of the *Body*, that procreate thoſe obſcure *Senſations* of *Good* and *Evil*, which happens to the *Body*, as DESCARTES intimates in his Epiſtles. *Behold*, ſaith he, four *Paſſions*, *Joy*, *Love*, *Sadneſs* and *Hatred*, *which I ſuppoſe being firſt in us, we had before our Birth, and judge them to be no other than very confuſed Senſations or Cogitations; in regard the Soul was ſo tied to Matter, that it could not yet attend but to thoſe divers impreſſions, that were to be received from it: And tho' after ſome years, it began to be affected with other Joys, and other Loves than thoſe which depend only upon a right Diſpoſition, and convenient Aliment of the Body; nevertheleſs that which was Intellectual in its Joys and Loves, had always concomitant thoſe Senſes which the ſaid Paſſions firſt excited in it; yea, and thoſe Natural motions and functions which were then in the Body.*

XII. *Which appears in Love.* So by reaſon, that before the *Nativity Love* did not ariſe but from a convenient *Aliment*, which flowing in great plenty into the common *Ocean*, the *Heart* and *Lungs*, excited in them a greater heat than uſual; hence it is, that the ſaid heat always accompanies *Love*, tho' proceeding from far different *Cauſes*.

XIII. *Three degrees to be obſerv'd in the Paſſions.* Now we may obſerve, that there is a threefold degree in the *Affections* of the *Mind*, anſwerable to a threefold degree of the *Senſes*. The *firſt* is the *commotion* or *alteration* of the *Heart*, the *Blood* and the *Animal Spirits*: The *ſecond* being a conſequent from the firſt, is the perception of the *Mind*. And laſtly, an acceſs of perturbation of *Mind*, ſo far as it precipitates inclination or averſion of *Judgment* or *Will*, is the third degree in the *Affections*.

CHAP. VII.

In what part of the Body the Soul receives its Paſſions.

I. *The Soul is joind to the whole Body.* FRom what hath been ſaid, is ſufficiently manifeſt, that *Human Soul* is joind to the whole *Body*, and that the *motions* thereof ſo depend upon its *Cogitations*, that they may be ſaid to make one compound. Hence that common ſaying among *Philoſophers*, *That the Soul is whole in the whole Body, and whole in each part thereof:* Not that the *Soul* can poſitively, and by true extenſion be found in each part of the *Body*, for that is repugnant to immaterial *Subſtance*, ſuch as we have already demonſtrated *Human Mind* to be; but becauſe the *Body* is one certain thing, and in a certain peculiar Senſe *Individual*, namely in reſpect of the diſpoſition of the *Organs*; all which are ſo mutually related one to another, that any one being taken away, the *Body* is thereby rendred maimed and imperfect; and ſince ſuch is the Nature of the *Soul*, that it is void of all *Extenſion* and *Dimenſions*, it can be referr'd to no Member of the *Body* ſo as to equal its quantity, but only to the whole *Compages* of the *Organs* which is conſidered as one; whence it comes to paſs, that any part of the *Body* being cut off, the *Soul* could not be conceived a jot leſs, nor if any could be added, a jot greater.

II. *Human Mind is in a peculiar manntr in the brain.* But tho' the *Soul* were joind to the whole *Body*, yet it could be ſaid more intimately and immediately to be united to one part than another. Thus GOD, tho' he be diffuſed through the whole *World*, and by his *Power* in a manner fills all places, yet in a peculiar way he may be ſaid to be in *Heaven*, where he *Governs* and *Rules* all *things* as he pleaſeth. So we ſay, that *Human Mind* reſides in the *Brain*, as in the upper part or *Cittadel* of the *Body*; and that not promiſcuouſly neither in all its *Parts*, but more eſpecially it hath its *Seat* in the *Conarion*, whoſe office it is to receive the *Animal Spirits*, and to unite in it ſelf the *Images* proceeding from *Corporeal Organs*: For this is that part, wherein the *Soul* moſt proximately and eſpecially exerciſeth its *Functions*, by perceiving and willing all things which proceed from the *Body*, or have their tendency into it.

III. *Of what uſe the Glandule in the Brain is.* The reaſon why ſuch a *Glandule* is aſſerted to be in the *Brain*, and to be the *Seat* of the *Common Senſe*, I have already declared, to which others may be added, whereof this is not the moſt inconſiderable, that our *Soul* is one and undivided, and conſequently it ſeems moſt conſentaneous to reaſon, that that part of the *Body* to which it is immediately joined be alſo one; and ſince there is no part in the *Brain* beſides this *Glandule* which is not double, it ſeems moſt probable to be the *Seat* of the *Soul*; and that which conduces not a little to the confirming of this *Opinion* is, that this *pineal Glandule* is as it were ſeated in its *Throne*, from whence it may, as I may ſo ſay, have a fair proſpect into all the 4 *Ventricles* of the *Brain*, and ſo may eaſily receive impreſſions from the *Nerves* that come from all parts: Moreover this *Glandule* is ſufficiently agile and moveable, as being hung upon two *Nervous ſtrings*, ſo that it may be moved this way or that way, according to the arbitrement of the *Mind*; which is the thing chiefly required in the common *Senſorium*, for otherwiſe the *Spirits* could not tend one way more than another.

IV. *That the Paſſions chiefly reſide in the Brain.* Theſe things thus briefly ſtated, it muſt be concluded, that the *Paſſions* have their chief reſidence in the *Brain*, not in the *Heart*, as ſome would have it; ſince when ever there are *Cogitations* or *Senſes*, as above noted, they are produc'd by the *Mind* in the *Brain*; nor is what we affirm rendred invalid by ſaying, that the *Paſſions*, which are always accompanied by ſome commotion of the *Blood* and *Spirits*, may be as it were felt in the *Heart*, for that ſo happens becauſe all the *Nerves* of our *Body*, are extended as certain *Filaments* into all parts of the *Body*: So that when it ſuffers *Pain* in any of the *Members*, for Examples ſake, in the *Foot* or *Leg*, it is not to be imagined that the *Soul* makes uſe of its faculties in thoſe *parts*; but rather that it feels *Pain*, by

the miniſtry of thoſe *Nerves* which are extended from the ſaid *Members* to the *Brain*. No otherwiſe than when one end of an extended *Rope* is drawn, the other is immediately moved, as hath been above declar'd.

V. *In what Order the Paſſions are form'd.*

So the *Blood* being well tempered, and expanding it ſelf more than uſually in the *Heart*, the little *Nerves* being diffuſed about its *Orifices* are ſo looſened and agitated, that there follows thence another *motion*, which affects the *Mind* with a certain Natural *Senſe* of *hilarity* or *chearfulneſs*. So upon the imagination of the *fruition* of any *good*, the *Spirits* are ſent from the *Brain* to the *Muſcles*, and by their help the *Orifices* of the *Heart* are dilated, and its *Nervules* mov'd in that motion, from whence the *ſenſe* of *Joy* cannot but follow. In like manner, upon the receipt of a grateful *meſſage*, as ſoon as the *Mind* perceives it, the *Spirits*, from the *Brain*, flow to the *Muſcles* of the *Bowels*, and there moving the *Nervules*, by their means excite another motion in the *Brain*, which affects the *Mind* with a *lively ſenſe* of *Joy*. And by the ſame reaſon, the *ſenſes* of *Sadneſs*, *Love*, *Hatred*, *Anger*, *Fear*, &c. are communicated to the *Brain* through the *Nervules* of the *Bowels*, and there immediately, and moſt eſpecially affect the *Mind*, and conſequently reſide therein, as in their primary *Seat*; but in the *Heart* and other parts affected by them, as in their ſecundary *Seat*.

VI. *It is not neceſſary that the Soul be in the Heart, thereby to perceive Paſſions.*

Therefore whilſt in the *perturbations* of the *Mind*, we obſerve a certain alteration, as it were, inhering in the *heart*; we muſt certainly conclude, that our *Mind* perceives not but by the help of ſome *Nervule* which reaches from the *Brain* to the *Heart*; and there is no more neceſſity that the *Soul* ſhould immediately exerciſe its *functions* in the *Heart*, becauſe it feels its *Paſſions* therein, than that it ſhould be in *Heaven* as often as it perceives the *Rays*, and the *Globular Preſſion* made by the *Sun*.

VII. *The more vehement Motions of the Spirits may diſturb the Soul.*

Hence it often happens, that divers *affections* ariſe in the *Soul*, namely, when the *Spirits* are otherwiſe diſpoſed by the *Mind*, than by the *Objects*, or their own temperament. In regard that *Human Mind*, tho' it be wholly rational, yet does it not always make good uſe of its own *reaſon*, but is greatly diſturbed by *external things*; ſo that the *Body* by its *Spirits*, and the *Soul* it ſelf by its *Will* may excite different *Motions*; and herein conſiſts thoſe conflicts which are vulgarly ſaid to interceed between the lower and upper part of the *Soul*. For ſince all our *perceptions*, as well thoſe which proceed from the *Will*, as thoſe which depend upon the Impulſes of the *Spirits*, contain ſomething evident in them, that may invite to proſecute this or that *Object*; this by *Love*, that by *Hatred*: the *Glandule* may be drawn one way by the *Soul*, another way by the *Animal Spirits*; from which different *motions*, the *Soul* feels it ſelf alternately inclin'd, one while to take one part, another while the other; and in this one thing conſiſts their repugnance: yet not ſo, as that the *Soul* can at one and the ſame time be carried two contrary ways, or the *Glandule* be at the ſame moment inclin'd to oppoſite parts, but only upon this account, that the *force* wherewith the *Spirits* incline the *Glandule* on one ſide, and wherewith the *Mind* ſtruggles with its *Will* on the other ſide, hath this effect, that the *Soul*, almoſt at one moment, feels it ſelf ſtirr'd up to have an *affection*, and *averſion* for one and the ſame *Object*.

CHAP. VIII.

Of the Order and Number of the Paſſions.

I. *Paſſions are made different from their Objects.*

ALthough the *Soul* depends not upon *Corporeal Objects*, ſo as to *think*, and without any *material Species*, to be able to comprehend all ſorts of *things*: And tho' in the forming of the *Paſſions*, it ſometimes makes uſe of its own *intelligent faculty* alone, and can at pleaſure apply it ſelf to conceive ſometimes one *Object*, ſometimes another; yet it is manifeſt from what hath been ſaid before, that the *paſſions* may alſo be excited by *Objects* which move the *Senſe*: Nay, and that theſe *Objects* are the moſt eſpecial and common *principles*: ſo that to find *paſſions*, there needs nothing but to weigh the nature of the *Objects*, and to take notice of the *Effects* which proceed from them. But becauſe in *man* they are many and various, and many times ſo confus'd among themſelves, that they can ſcarce be diſtinguiſht from each other; we muſt mind the diverſities of *Objects* which preſent themſelves to our *Senſes*, that by the perception of them, we may the more eaſily arrive at the knowledge of thoſe *affections* which are begotten in us. Yet there is no neceſſity that all the diverſities of *Objects* ſhould be examined; but thoſe alone which can either profit or hurt us, or any other way be relating to us.

II. *The Soul is void of partition, and conſequently ill divided into Iraſcible and concupiſcible.*

Wherefore the better to enumerate the *Paſſions*, we are only to take notice how many ſeveral ways *Objects* may concern us, or may act upon our *Senſes*, ſo as to profit or hurt us. Nothing is more frequent in *Schools*, than to take the *Soul* in pieces and to divide it, I know not by what Art, into *Senſitive* and *Rational*, by which they conſtitute two Appetites in the *ſenſitive part* of the *Soul*; whereof one they call *concupiſcible*, which reſides in the *Body*, and tends wholly to its *Conſervation*; the other *Iraſcible*, which comes nearer to *Reaſon*, and ſupplies it with *ſtrength* and *vigor*. But hence aroſe this Error of aſſigning 2 *perſons* as it were in a Scene, that they did not carefully diſtinguiſh the *Functions* of the *Soul* and *Body*, but attributed to the *Soul* thoſe *Offices* which belong to the *Body* only. For whatſoever oppoſes *Reaſon*, cannot proceed but meerly from the *Body*, which comes to paſs when the *Animal Spirits*, which are alſo *Bodies*, hit by an oppoſite way upon the *Glandule*, and by their *power* endeavour to hinder the effect of the *Soul*. For in one *Body* there is to be conſidered but one *Soul*, void of all *parts*, and being but one and the ſame, called both *Senſitive* and *Rational*.

III. *There are divers faculties in the Soul.*

But if thoſe *Authors*, who admit 2 *Appetites* in the *Soul*, only mean this, that the *Soul* is indued with 2 *Functions*, the one of *Luſting*, the other of being *Angry*, we ſhall not gainſay them; but whereas it hath the *faculties* not only of being *Angry*, and being *Concupiſcent*, but alſo the faculty of *Admiring*, *Hoping*, *Fearing*, there ſeems to be no reaſon that all *affections* ſhould be referred to *Concupiſcence* or *Anger*; when as *Admiration*,

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miration, which is the primary *Affection*, hath no relation either to *Concupiſcence* or *Anger*.

IV. *Admiration the firſt Paſſion that occurs to us.* Therefore another way muſt be found out to enumerate the *Paſſions*; and in my mind there can be none more convenient, and more certain, than for all the *motions* of the *Mind*, which occur to us, to be conſidered in their *Order*. For as ſoon as any thing preſents it ſelf to us, or appears under any *ſpecies* which hath no ſimilitude with any thing we knew before, it cauſes the *Soul* to be ſurpris'd at the ſight thereof, and to remain ſome time in *contemplation* upon it; and in regard this may poſſibly happen before we have well conſidered whether the ſaid thing repreſented to us be *good* or *bad* for us, it hence follows that *Admiration* is to be accounted the firſt of all thoſe *Affections* which are inbred in us; but ſince it happens that we either *admire* the excellency of any admirable *Object*, or contemn the deſpicableneſs of any other, either *Eſteem* or *Contempt* muſt needs accompany this *Admiration*, and by this means *Magnanimity* or *Abjection* of *Spirit* are created in us; namely, while we either extol our ſelves for ſome juſt *cauſe*, or contemn our ſelves for that puſillanimity which we find to be in us: But when we eſteem greatneſs of *Action* in other *perſons*, whom we eſteem capable of doing *Good* or *Ill* to *Mankind*; from ſuch an eſteem as this proceeds *Veneration*.

V. *The next are Love, Hatred, Cupidity, Hope, and the like,* In the next place, when the *Soul* conſiders under ſome qualification an *Object* of *Good* or *Evil*, that is, of what is either agreeable or ungrateful to us, having no regard to difference of time therein, it excites either to *Love* or *Hatred*; forasmuch as *Love* is an *Affection* of *Union*, as *Hatred* is of *Separation*. But when reſpect is had to time, that is, when a *man* is more carried on to the *Contemplation* of the future, than of the preſent or paſt *time*; a future *Object* is expected, either as only *poſſible*, or moreover as *eaſie or hard to be obtained*. From the former conſideration is kindled *Cupidity*, by which not only the preſence of an *abſent Good*, and the conſervation of what is poſſeſt is *deſired*, but alſo the *Abſence* of an *Evil*, as well preſent as in *apprehenſion*. But if a thing be repreſented, not only upon the account of *poſſibility*, but alſo as eaſie of acquiſition, it begets *Hope*, the utmoſt degree whereof is *Truſt* or *Security*. But if it be lookt upon as difficult to be obtain'd, it creates *Timidity* or *Fear*, the utmoſt degree whereof is *Deſpair*: Hitherto may be referred *Doubtfulneſs* or *Fluctuation* of *Mind*, when we diſpoſe our ſelves to deliberate or enter upon *Counſel*.

VI. *Here follow thoſe Paſſions which conſider Good and Evil as preſent.* Laſtly, when *Good* and *Evil*, as being conſidered to have relation to us, are preſent, they produce 2 other *Effects*; the firſt *Joy*, the other *Sorrow* or *Sadneſs*. But when we look upon them as relating to others, we judge thoſe *perſons* either worthy or unworthy of ſo great a *Good*. If worthy, it produceſs *gladneſs* in the *Soul*, either Serious or mixt with Deriſion: If unworthy, the *good* which attends upon them ſtirs up *Envy* or *Heartburning* in us; and if *bad* attend them, it ſtirs up *Commiſeration*, which is a kind of *ſadneſs*.

VII. *Acquieſcence, Penitence, Glory, &c.* In an *Object* paſt, or even alſo preſent, attention may be had to the Cauſe of *Good* or *Evil*. A *Good* which has been done by us, if it relate to opinion we have of it as *Good*, it begets an inward *acquieſcence* or *contentment*, which is the ſweeteſt of all *paſſions*, and wonderfully delights the *Soul*; whereas an *Evil* done, if it relate to the *Opinion* we have of it as *Evil*, brings forth *repentance*, which is the moſt troubleſom of all the *paſſions*, and inceſſantly diſturbs and afflicts the *Soul*. A *Good* done by us, as it relates to the *Opinion* which others conceive of it, produces *Glory*; on the contrary, *Evil* ſo relating, *Shame* and ſenſe of *Diſgrace*. If a *Good* be conferred upon us by another, we teſtifie our *Gratitude* towards him: If the ſame *Good* be beſtowed upon another, he is the *Object* of our *Favour*: On the other ſide, if an *Evil* be inflicted on others, it cauſes our *Indignation*; if on our ſelves, our *Anger*; which two laſt *Affections* may be ſaid to be *ſpecies* of *Hatred* or *Averſion*. A long *Duration* or *Continuance* of *Good* induces *Satiety* or *Loathing*; as on the contrary, *Duration* of *Evil* diminiſheth *Pain* or *Miſery*, and renders it more light and tolerable.

VIII. *Deſire, Hilarity, &c.* Laſtly, from a paſt *Good*, upon remembrance of the *Joy* thence received, there ſprings up *Deſire*, as from an *Evil* happily ſurmounted, *Hilarity* ariſeth, which may be referred to *Joyfulneſs*. Now altho' we have here enumerated ſeveral ſorts of *Paſſions*, yet if they be each of them well conſidered and examined, it will ſoon appear, that many of them are referrible to others as *primitive* ones, which are reckoned ony 6 in number, namely *Admiration*, *Love*, *Hatred*, *Cupidity* or ſenſual deſire, *Joy* and *Sadneſs*: The reſt are *ſecundaray*, being either compounded of many of them, or referrible to them as to their *Genus*'s.

CHAP. IX.

Of Admiration.

I. *Admiration precedes all other Paſſions.* *Admiration* leads up a Troop of *Paſſions*, being the firſt and chief of all that affect *Human Mind*, and upon which all the reſt, in ſome ſort or other, depend. For as in other *Functions* of the *Soul*, *Apprehenſion* preceeds *Judgment* and *Diſcourſe*, and it is neceſſary that ſome *Object* be repreſented before ſuch time as the *Soul* gives or denies aſſent thereunto: So any thing whatſoever is perceived by *Admiration*, before any one can proſecute it with *Love* or *Hatred*, or can *Covet* it, or conceive *Joy* by the obtaining of it, or *Sorrow* by the want of it.

II. *The definition of Admiration.* *Now Admiration is a ſuddain impulſe of the Mind, by which it is led to an attentive conſideration of thoſe Objects which ſeem unwonted to it, and with the novelty whereof it is ſurpris'd.* This *Paſſion* belongs to the *Brain* alone, and hath no commerce with any other parts of the *Body*, as other *Paſſions* have, which are referred to the *heart*, and which the *motions* of the *Blood* and *Spirits* ever accompany. That this is peculiar to *Admiration*, may be collected from hence, namely, that when ever this *Paſſion* is imploy'd in the attention of the thing perceived, and only regards the novelty thereof, it hath no conſideration therein either of *Good* or *Evil*, and conſequently hath no correſpondence with the *Heart* and *Blood*, upon which the whole concern of the *Body* depends, but only with the *Brain*, in which are laid up all thoſe *Inſtruments* which conduce to the forming of this *Cognition*.

The

III. *What produces Admiration.*

The Cauſe of this *Affection* is the very Impreſſion made in the *Brain*, according as it repreſents ſome Extraordinary *Object*, worthy the *Souls* Employment and Attention. For the *Novelty* of the thing hath ſomewhat of Gratefulneſs, which takes the *Beholders*, and draws their *Contemplation* to it. Hence it comes to paſs, that we admire all things that are Novel, and thoſe always pleaſe moſt that came lateſt into our *Senſe*. To confirm what hath been ſaid, the *motions* of the *Spirits* are not a little conducing, which are diſpos'd by that *Impreſſion*, and with great Violence direct their *Courſe* towards that part of the *Brain* in which it was form'd; and ſo far as they receive from it a diſpoſition to paſs into the *Muſcles*, which ſerve to retain the *Organs* of the *Senſes* in the ſame Poſition.

IV. *The force and efficacy of Admiration.*

Altho' *Admiration* takes beginning in the *Brain*, and is wholly employ'd in the *Contemplation* of a New and unwonted *Object*; yet nothing hinders, but that by the ſaid *Impreſſion* which it makes in the *Brain*, it may act upon our *Body*, and imitate the Efficacy of other *Paſſions*. Nay, ſometimes it grows ſo prevalent, that it ſeizeth on our *Body* more ſtrongly than they, and exerciſes its Power upon it much more forcibly; which chiefly proceeds from hence, namely that the *Novelty* from whence it ſprings, brings forth *Motions* the moſt prompt of all, and ſuch as have their whole ſtrength *at the beginning*. Nor can it be doubted, but that theſe ſort of *Motions* are ſtronger, than thoſe which are increas'd by degrees, and have no *ſtrength*, but what they acquire by little and little. Since it is moſt certain, that ſuch like *Motions* may either be averted, or ſtopt by little labour; whereas the ſudden Surprizal of a *New thing*, admits of no ſuch averſion, ſince it can ſcarce be diſcern'd, and inſinuates it ſelf in a moment. For as we can ſtir *Hand* or *Foot* almoſt in the ſame Moment in which we think of *Moving* them; in regard the *Idea* of this ſort of *Motion*, which is form'd in our *Brain*, ſends *Spirits* into the *Muſcles*, fit to effect that ſaid *Motion*: So the *Idea* of a grateful *Object*, which comes unawares into the *Mind*, immediately by the help of the *Nerves*, ſends *Spirits*, which opens the *Orifices* of the *Heart*. Nor does *Admiration* any thing elſe in this buſineſs, but by its Novelty add *Strength* to the *Motion*, and cauſes the *Blood*, which upon the ſudden dilating of the *Orifices* of the *Heart*, flows through the *Vena Cava* into it, and goes out through the *Vena Arterioſa*, ſuddenly to inflate and expand the *Lungs*.

V. *A Novelty affects the Brain in an unwonted manner.*

To which *Reaſons* another alſo may be added, namely, That thoſe Things which outwardly excite *Admiration*, when they are New, and have not yet arriv'd through our *Senſes* to the *Brain*, ſtrike it in ſome certain Parts, where it hath not been ſtruck before; and ſince thoſe Parts of the *Brain* are more ſoft and tender than the reſt, it falls out that they receive the Stroak deeper, and the *Affections* of the *Motions* which are there begotten, are, by reaſon of their unwontedneſs, render'd more Vehement.

VI. *Eſteem and Contempt, Species of Admiration.*

There are 2 *Species* of *Admiration*, *Eſteem* and *Contempt*, which are not to be taken for ſimple *Opinions*, that without *Paſſion* may be entertain'd concerning the Value of any thing whatſoever, but for the *Affections* which ariſe from thoſe Opinions: *Eſteem therefore is a propenſion of the Soul, produc'd by the Motion of the Spirits, to repreſent to its ſelf the Value of any thing whatſoever. And Contempt is the oppoſite propenſion which the Soul hath to conſider the Littleneſs or Vileneſs of the thing Contemn'd*: which *Paſſions* may be referr'd not only to *External Objects*, but even to our ſelves; as namely, when we ſtrictly enquiring into our ſelves, find Reaſon to ſuſpect or deſpiſe our own *Merit*. But in regard we often flatter our ſelves, and judge that more laudable, which is done by our ſelves, than by others; it will be worth our while to underſtand what it is, for which we may entertain a Self-eſteem. And truly, I can ſee nothing that I judge can be Entituled to this *Merit*, but the right uſe of our *Free will*, and that *Greatneſs* of *Soul* by which we govern our *Wills*, and ſubdue them to the Yoak of *Reaſon*. Foraſmuch as other *Goods*, which are out of our power, can conduce nothing to our Good, and conſequently deſerve not our Eſteem or Praiſe. Only thoſe *Actions*, which depend upon our *Will*, can confer upon us the *Merit* either of *Praiſe* or *Diſpraiſe*; ſince by the uſe thereof we are render'd in a ſort like to *GOD*, and come ſo much the nearer to his *Image*. In this alone true *Generoſity* conſiſts, when a *Man* well knowing that nothing properly is his own, except the free diſpoſition of his *Will*, duly Values himſelf as he ſees Cauſe, upon the right uſe of his *Reaſon*, and retains a firm purpoſe always to act thoſe things which he ſhall judge to be moſt Excellent.

VII. *What Veneration is.*

Veneration, which conſiders *Objects* without us, is *an Inclination of the Soul, by which it is carried, not only to Eſteem the Perſon which it honours; but alſo to Subject it ſelf to him with a certain Fear, for the ſake of gaining his Favour*. Whence it comes to paſs, that *Veneration* proceeds only from the Conſideration of *Power*, which we conceive to be in a Free *Agent*, wherewith he is able either to *benefit* or *hurt* us; although all this while we know nothing of his *Will*, that is, we are not certain which of the two will befall us, *Good* or *Harm*. So in Old times, ſome venerated *Mountains*, *Temples* and *Groves*, not that they believ'd, that theſe *Works* of *Art* and *Nature* were *GODS*; but becauſe they imagin'd, that certain *Divinities* lay hid in them, which might at their pleaſure either do them *Good* or *Hurt*.

VIII. *Effects of Dedignation.*

To this Paſſion, *Dedignation* or *Diſeſteem* is oppos'd, by which we deſpiſe *Free Cauſes*, though at the ſame time we judge them to have power of doing *Good* or *Harm*; becauſe we think them ſo much beneath us, as not to be capable of Executing their ſaid *Power* upon us.

IX. *An Exceſs of Admiration begets Stupour.*

Stupour, or *Amazement*, is an Exceſs of *Admiration*, which happens to us when a ſudden *Surprizal* cauſes the *Spirits*, which are included in the Cavities of the *Brain*, ſo to advance to that place in which the *Image* of the *Object*, which we admire, is form'd, as ſometimes to carry all to the ſaid place, and to make them ſo employ'd in Conſerving that *Image*, that from thence to the *Muſcles*, from thoſe *Veſtigia* which they firſt follow'd in the *Brain*, no way lies open to any others. Whence it happens, that the *Body* remains wholly immoveable in that State wherein it firſt was; and

To the Right Noble and Counteſs of Viſcounteſs Falmouth &

Catherine Dutcheſs Northumberland Baroneſs of Pontefract &c.ª

This Plate is humbly Dedicated by Richard Blome

and nothing but the first *Image*, which first occurr'd to the *Mind*, can be deprehended, nor can a more exact Knowledge thereof be thereby gain'd.

CHAP. X.

Of Love and Hatred.

I. *Why Love and Hatred are to be treated of together.*

ALtho' *Hatred* be oppos'd to *Love*, and they both of them never agree in the same *Person*, about the same *Object*, nevertheless it is Expedient to joyn both together in this one *Chapter*, that by comparing the Nature of them both, one with another, it may the more appear wherein they most chiefly differ.

II. *The Definition of Love.*

LOVE is defined, *a Perception or Commotion of the Soul, generated by a special Motion of the Spirits, whereby it is excited to joyn it self by its Will to those things which seem grateful to it.* On the contrary, *HATRED is a Commotion of the Soul, produc'd by the Spirits, by which it is incited to separate it self, by its Will, from Objects which are represented as ungrateful and noxious to it.* But in regard the *Soul* applies it self to those things which it judges *Good*, and is averted from the very same things, so far as they are represented to it under the Notion of *Evil*; not only by *Love* and *Hatred*, but also by *Judgment*; we add, that *Love* and *Hatred* are caus'd by the *Motion of the Spirits*, which is peculiar to all *Passions*, and which separates them from other Perceptions of the *Soul*. To joyn our selves by *Will* to any *Object*, is not to tend to that which is future, and to covet it as a thing *absent*; but to consent by *Affection*, which happens when we consider our selves, as it were already joyn'd to the *thing belov'd*, that is, when we conceive our selves to make up, as it were, one *Total* with it, and whereof we think our selves to be but one part, and the *Beloved thing* another. But in *Hatred*, we consider our selves as a *Total*, wholly separated from the *Object*.

III. *What things produce Love or Hatred.*

The *Causes* of these *Affections*, are *Objects* which may be represented to the *Soul* by the *Internal Senses*, to wit, its own proper *Reason*. For that is generally accounted *Good* or *Evil*, which is judg'd by our *Internal Senses*, either agreeable or contrary to our *Nature*. Or else by the *External Senses*, by which the *Beauty* or *Deformity* of things is apprehended. For we commonly judge those things *Beautiful* or *Deformed*, that court or offend our *Sight*; which, in that particular, excells all the rest of our *Senses*. Hence we are inclin'd to things *beautiful* and *fair* by that part of *Love*, which may rightly be call'd *Complacence*. *Evil* and *Deformed things*, we prosecute with *Hatred* and *Horreur*. The said *Love* may also be called *Benevolence*, in regard we affect not all things with the same *Affection*: For according to the Esteem we have of them, we love some things more, and some things less; whence *Philosophers* have been forc'd to invent several *Names*, for the making a distinction between some sorts of *Love* and others.

IV. *There are three sorts of Love.*

For when we set a less Value on any *Object*, than upon our selves, and think it inferiour to us, we may be said to have a *Propension*, or sort of *Benevolence* towards it. When we have the same Value for it as for our selves; and Opinion of *Merit* makes no difference between us and that, we are tied to it by that which we call *Friendship*. But if we place more Worth and Merit upon the *Object*, and admire it above our selves, it becomes the *Object* of our *Devotion*, *Reverence*, or *Worship*. So that *Love* may be distinguish'd into *Benevolence*, *Friendship*, and *Devotion*, as into three *species* or diversities, wherein it wholly consists: For things *Inanimate*, or *Animals* void of Reason, may be belov'd; but no such thing as *Friendship* can be; but between *Man* and *Man*; that is, not as to the *Sex*, but as between one *Human Creature* and another; in whom it is so innate to be United each to other, that neither of them can be so vile or contemptible in the others *Eyes*, as not to be thought worthy to be joyn'd to the other by some Tye or Relation, provided he know that he is *belov'd* and be indued with a *generous Spirit*.

V. *Devotion is chiefly directed to the Deity.*

But by *Devotion* we are affected most chiefly to the *Supream Deity*, whom if we knew to that degree as were fit, we could not but *love*, tho' it may be said that *Subjects* to their *Prince*, *Natives* to their *Country*, *Citizens* or *Towns-men* to the *City* or *Town* where they were born or bred, are carried with a sort of *Devotion*, as Valuing the said *Objects* thereof above themselves, and thinking it their Duty to expose, if need be, their own *Lives* upon their account.

VI. *The Causes of Love are in divers Parts of the Body.*

The *Cause of Love and Hatred*, as also of the three other *Passions*, is not, as that of *Admiration*, in the *Brain* alone; but also in the *Heart*, *Liver*, *Spleen*, and other Parts of the *Body*, which conduce to the generation of the *Blood*, and the conveyance of the *Spirits* thence. For altho' the *Blood* is carried to the *Heart* through the *Veins*, by a *Circular motion*; yet sometimes it happens to be impell'd into it with a more violent Force through some *Veins*, than through others. It happens also, that the *Passages* by which the *Blood* enters into the *Heart*, or by which it issues out of it, are by some Accident or other, made more wide or more narrow. Hence in *Love* there arises a Notable agitation of the *Blood* and *Spirits*, when the Impression of the *Lovely Object*, form'd in the *Brain*, conveys the *Animal Spirits* through the *Nerves* of the *9th Conjugation*, to the *Muscles* of the *Stomach* and *Intestines*, that so the *Chyle* or *Alimental Juice*, which by an iterated Circuit passing through the *Heart*, is turn'd into *Blood*, may pass on very swiftly to the *Heart*, and makes no stay either in the Vicine parts, or elsewhere; but with a rapid Course entring into it, stir up a more than ordinary fierce *heat* or *fire* therein: Because then the *Blood* becomes rarefied, and sends the more enlivened *Spirits* into the *Brain*; which *Spirits* corroborating the Impression which the first *Perception* of the amiable *Object* forms, *Cause* the *Soul* to rest in that Perception, and to take notice of the said *Object*, as acceptable and good.

VII. *Hatred proceeds from different Causes.*

On the contrary in *Hatred*, the first perception of the thing we have an aversation to, so draws down the *Spirits* which are about the *Intestins* and *Stomach*, that they hinder the *Chyle* from mixing with the *Blood*, that is, by Compressing all the *Orifices*, by which it uses to flow down thither, and at the same time transmits some of this *Chyle*

through the *Nerves* of the *Milt*, and lower part of the *Liver*, which is the receptacle of *Choler*, with other *Blood* to the *Heart*, which cauſes no ſmall inequality in its *Heat*, becauſe the *Blood* that proceeds from the *Milt*, hardly ſuffers alteration, and can ſcarce be *Heated* or *Dilated*: Whereas the *Blood* that proceeds from the lower part of the *Liver*, which is the receptacle of the *Gall*, is rarefied and expanded in a Moment. Wherefore the *Spirits* tranſmitted from the *Heart* toward the *Brain*, conſiſt of parts of different Vertue, and are agitated with unequal *motions*. Whence it comes to paſs, that they there corroborate and fortifie the *Thoughts* of *Hatred*, which they find newly formed, and weary the *Soul* with thoughts of *Melancholy* and *Sourneſs*.

VIII. *Various effects of Love.*

There are reckoned up many effects of *Love*, as the *Pulſe* of the *Arteries* being equal and more intent and vehement than uſual; a calm *Heat* glowing in the *Heart*; a ſuddain Concoction of the *Meat* in the *Stomach*, and the like; but the moſt principal of all, and which moſt chiefly requires our conſideration, is a kind of *Languiſhment*, which is no other than a certain proclivity to a ceſſation of *motion*, which proceeds from hence, namely, that the *Pineal Glandule* diſpoſes not the *Spirits*, which are in the Cavities of the *Brain*, to flow into one *Muſcle* rather than another. This *Languour* is produc'd by *Love*, when the thing deſired cannot for the preſent be obtained, for then *Love* ſo detains the *Soul* in the Cogitation of the beloved *Object*, that it makes uſe of all the *Spirits* in the *Brain*, to repreſent to it the *Idea* thereof, and ſtops all other *motions* of the *Glandule* which conduce not to this effect.

CHAP. XI.

Of Affections.

I. *Cupidity no leſs diſturbs us than thoſe Paſſions that reſpect the future.*

Since all the *Affections* of the *Soul*, except *Admiration*, tend towards *Good* and *Evil*, and are given us by nature, for the aiming at what is profitable, and rejecting of what is hurtful to us; it is to be conſidered how many ways it may be done: For ſince in *Love* and *Hatred*, there is no reſpect had of time, and only the convenience or inconvenience of the *Object* is lookt upon, theſe *Paſſions* ſeem to agitate, no leſs than thoſe which tend towards the future, and ſeek after the *Object* with a kind of *Anxiety*: Hence the *Cogitations* of *young Men* which regard things to come, are more precipitous, and more ſharply moleſt and diſquiet their *Minds*, ſuch as are *Hope*, *Fear*, *Jealouſy*, *&c.* which are ſpecies of *Cupidity*.

II. *What Cupidity is, and how it comprehends as well an averſation of Evil as deſire of Good.*

Cupidity therefore or deſire is a commotion of the Soul produc'd by the Spirits, whereby it is carried towards Good as a thing to come, by which *Paſſion* we not only wiſh for an abſent thing, whoſe preſence we judge convenient for us, but likewiſe the conſervation of the thing poſſeſſed; nay, if we ſtrictly inquire into the Nature of *Cupidity*, we by it no leſs deſire the abſence of an *Evil* not preſent, than the preſence of that which is *Good*, and which we apprehend may poſſibly happen, ſo that *Cupidity* comprehends not only the deſire of *Good*, but alſo the declining or averſation of *Evil*: For as much as to ſpeak properly, there is one and the ſame agitation of *Mind*, by which at the ſame time we are moved to aim at ſome *Good*, for Example ſake, *Honours*, and to decline a contrary *Evil*, that is to ſay, *Ignominy* or *Diſgrace*: For ſince there is no aſſignable *Good*, whoſe privation is not an *Evil*, nor any *Evil*, if it be conſidered under a poſitive reſpect, whoſe privation is not a real *Good*, there ſeems no reaſon to diſtinguiſh between that Appetite by which we affect the *Good*, and that by which we decline and reject its contrary.

III. *The Difference between avoiding Evil, and deſiring Good.*

All the difference that can be conceived in them, proceeds only from the *Paſſions* which accompany this various deſire, namely, becauſe to the *Cupidity* by which we tend to any *Good*, there are annext *Love*, *Hope*, *Joy*, *&c.* and to the ſame *Cupidity*, by which we are carried to the *Averſation* of any *Evil*, there are joyn'd *Hatred*, *Fear* and *Sadneſs*; wherefore if *Cupidity* be conſidered according as it tends to the Proſecution of *Good*, or *Averſation* of its contrary *Evil*, it cannot be a double *Paſſion*, but only one, which executes both parts.

IV. *This Paſſion is produc'd by the Animal Spirits.*

The cauſes of this *Paſſion* are the *Animal Spirits*, which paſs from the *Heart* to the *Brain*, and ſeem to cheriſh and preſerve the *Image* there firſt impreſs'd. For as ſoon as the *Soul* hath a *Will* to acquire ſome *Good*, which is grateful to it, or to remove ſome *Evil*; immediately it Tranſmits the *Spirits*, by the help of the *Glandule* to all parts of the *Body*, eſpecially to the *Heart*, that, ſo much the greater plenty of *Blood* as is received within its Cavities, ſo much the greater quantity of *Spirits* may be conveyed to the *Brain*, as well to conſerve, and corroborate therein the *Image* of the *Will*, as to move thoſe *Muſcles* that are neceſſary for the gaining of that which is deſired; whence it comes to paſs, that when the *Mind* deſires any thing, the whole *Body* is rendred more Agile, and becomes more chearful to execute all the offices of the *Body*, than at other times it uſes to be; namely, becauſe the *Heart* being more vehemently agitated, ſupplies the *Brain* with the more *Spirits*, which taking their courſe thence to the *Muſcles*, cauſe the *Senſes* to become more vivacious, or the *Members* of the *Body* more diſpoſed to *motion*.

V. *The ſeveral ſpecies of Cupidity.*

To *Cupidity* or Deſire, as hath been ſaid, are reduced *Hope*, *Fear*, *Jealouſy*, *Security*, *Deſperation*, *Fluctuation* of *Mind*, *Animoſity*, *Boldneſs*, *Emulation*, *Puſillanimity* and *Conſternation*.

VI. *The Definition of Hope.*

Hope is a diſpoſition of the Soul, produc'd by a ſpecial motion of the Spirits, to believe that that will come to paſs, which it deſires. So that no *Object* can ſtir up *Hope*, unleſs it be repreſented to the *Mind*, as eaſie to be obtained.

VII. *Of Fear.*

Fear, is another diſpoſition of the Mind, *by it perſwades it ſelf that that which it deſires, will not come to paſs*: Theſe two *Paſſions* however they are oppoſed, may nevertheleſs be found in the ſame, and at the ſame time, namely, when any one is perſwaded by different *Reaſons*, by ſome, that the *Object* he deſires may be eaſily, by others, difficultly acquir'd.

VIII. *Of Jealouſie.*

Jealouſie, which is referr'd to *Fear*, *is the* Fear *of loſing a good which we greatly eſteem, proceeding from the leaſt cauſes of ſuſpecting*; or when led by ſuſpicion only, we fear to loſe a certain good.

Fluctuation

C. Fremant. Inv. I. Ryther. Sculp.

To the Worshipfull Henry Gorges
of Eye in Here- fordshire Esqr

This Plate is humbly Dedicated by Richard Blome.

To the Worshipfull
the Inner Temple
Judges of the Sheriffs

James Mundy, of
Esqr. one of the
Court London.

This Plate is humbly Dedicated by Richard Blome.

IX. *Of Fluctuation of Mind.*

Fluctuation of Mind, is *the Fear of Erring in the choice of things, which tend to constitute the end, which while it retains the Soul in doubt, and suffers it not to perform one action more than another, causes it to perform none, and consequently hath a sufficient time left it to determine before it makes choice of any thing*: Which *Passion* is so prevalent in some *Persons*, that oftentimes when there is no need of deliberation, in the thing designed, nay when it is the only thing to be omitted or performed; yet nevertheless, they remain in such suspense, that they are altogether incapable of inquiry into other *things*.

X. *Of Animosity, Boldness and Emulation.*

Animosity is some certain Heat or Agitation, which disposes the Mind to act stoutly in the performance of those things which it designs. If any great danger attend the said things, it is called *Boldness*, which disposes the *Soul* to act those things, on which some great and imminent danger is attendant. *Emulation*, which is a certain *Species* of *Animosity*, ariseth from the consideration of other *Men's success*: Because when we see other *Mens undertakings* happily succeed, we are commonly moved by their Example to set upon the same thing, and in our Acting to Trace the same *Footsteps* as they have done. And this happens while the *Body* is so disposed, that *Cupidity* and *Hope*, have more strength to impel the *Blood* copiously into the *Heart*, than *Fear* and *Desperation* have to hinder it.

XI. *Of Pusillanimity and Consternation.*

To *Animosity*, *Pusillanimity* is directly contrary, and it is a *Languor* or *Coolness which hinders the Soul from going on to execute those things, which it would certainly execute, if it were destitute of the said Coolness.* And *Consternation*, which is opposite to *Boldness*, is joyn'd not only to the *Cold*, but also to the Stupidity and Perturbation of *Mind*, which disarms it of its *Power* and *Ability*, to oppose its self against those *Evils* which it expects, and thinks to be at hand.

CHAP. XII.

Of Joy.

I. *Gladness is the Term or Bound of all Affections.*

Gladness or *Joy* may be called the *Term* or *Bound* of all the *motions* of our *Soul*; which as they begin in *Admiration*, so they cease or terminate in *Joy* as in their own proper Scope or Aim: For desire of *Good* ceaseth in the obtaining of *Good*, and all inquietude is removed from us, as soon as we possess those things which we so greatly desired. In present *Joy Fear* ceaseth, *Sadness* is banisht, *Desperation* is destroyed, *Love* is at rest, and the rest of the *Affections* vanish, whilst we are wholly taken with *Joy* or *Pleasure*.

II. *The Definition of Joy.*

Gladness or *Joy* is a *pleasant commotion of the Soul, in which the possession of that Good consists, which the impressions of the Brain represent to it as its own.* We say, that the possession of *Good* consists in a pleasant commotion of the *Soul*, in regard it is as it were the only *Fruit* of all the *Goods* it has, which being taken away, it can no more be said to injoy them, than if it were totally deprived of them. To which it is properly added, *that that Good, by the impressions of the Brain, is represented to the Soul as its own*: That *Joy*, which is a *Passion*, may the more easily be distinguisht from that which the *Soul* experiments by *Action*, which that they may not be confounded, it will not be from the purpose to observe the Nature of each.

III. *Joy is twofold sensual and Intellectual.*

For *Joy* is twofold, one *Sensual* or which so depends upon the *Body* as to make it its principal *Object*, the other *Intellectual*, which is a pleasant commotion of the *Soul*, springing from a clear and distinct knowledge of the *Good* wich is apprehended: Which distinction is hence understood, namely, because the *Intellectual Joy* may sometimes be without the *Sensual*, as when from any good *Action*, we feel a satisfaction from that pure consideration that we have performed our *Duty*; altho' it be difficult to experiment it, so long as the *Soul* is in the *Body*, since the *Intellectual Joy* makes always some impression upon the *Body*, such as is required to the framing of a *Passion*, for there is so streight a Union between our *Soul* and *Body*, that tho' the *Good* which the *Soul* is sensible of belongs not to the *Body*; yet *Imagination* always fains some *Idea* in the *Brain*, from whence there follows a *motion* of the *Spirits*, which produces the *Passion* of *Joy*.

IV. *The External cause of this affection is the possession of a Good.*

The cause of this *Passion*, as may be gathered from its *Definition*, is the possession of some *Good*; for then the *Soul* seems to be satisfied, when it injoys that thing which it esteems to be its own *Good*, and to conduce to its Felicity; tho' it often happens, that we find our selves overjoy'd, and wrapt up in I know not what kind of Pleasure, when the cause of this change is utterly unknown: As when our *Body* is chearfully dispos'd, and with great alacrity performs its offices, but this proceeds from hence, namely, that the *Good* impresses some *Idea's* in the *Brain*, without the help of our *Soul*: That is, when the constitution of the *Brain* is such, that the *Animal Spirits* may the more easily be brought down into the *Nerves*, as well those which serve for dilating the *Orifices* of the *Heart*, as others. So when the *Heaven* is somewhat more than ordinary *Serene*, we feel a kind of Hilarity or Chearfulness in our selves, which proceeds from no Function of the *Intellect*, but only from the impressions, which the *motion* of the *Spirits* excites in the *Brain*.

V. *The Internal causes are the Blood and motion of the Spirits.*

The *Internal Causes* of this *Passion* are the *Blood*, and *motion* of the *Spirits*, not so much in the *Nerves* of the *Stomach* and *Intestines*, as in *Love*, or of the *Milt* and *Liver*, as in *Hatred*, as in those which are spread through the rest of *Body*, those especially which are about the little *Mouths* of the *Heart*. In regard they by opening and inlarging afford a way to the *Blood*, which other *Nerves* propel from the *Veins* to the *Heart*, that it may go in and out in greater plenty than usually; but because the *Blood* having many times before entred the *Heart*, and so flowing out of the *Arteries* into the *Veins*, is thereby more subtilized, it thereupon becomes the more easily rarefied and creates *Spirits*, which by reason of their equality are adapted for the forming and corroborating impressions of the *Brain*, which supply the *Heart* with joyful and serene *Cogitations*; whence it happens that so long as the *Soul* is affected with *Joy*, the *Pulse* of the *Arteries* is equal, and more quick than usual; moreover a certain grateful *Heat* is felt, not only in the *Breast*, but also in the External part of the *Body*, into which together with the *Blood* it is copiously transmitted.

The

VI. *The various effects of Joy.*

The most noted instance of *Joy*, and which is commonly observed in those that are therewith affected, is a *Lively Colour* and generally ruddy, which it paints in the *Countenance*, and which hence proceeds, namely, that *Joy* dilating the *Fibres* of the *Heart*, causeth the *Blood* more copiously to enter into the *Heart*; and being there more intensely warmed to be distributed the sooner into the *Veins*; and by this means excites a grateful and lively *Colour* in the whole *Body*, especially in the *Face*: Moreover, in the same affection of *Joy*, the *Spirits* happen to be so disposed; as that those which flow into the *Muscles* of the *Face* and *Breast*, make such a concussion of them, as to cause Cachinnation or bursting into a strain of *Laughter*, which sometimes is so great, that by the force thereof, the passages of the *Eyes* being opened, *Tears* thereupon gush out: For *Tears* are nothing else but *Vapours*, which in their passage out of the *Eyes*, are turn'd to *Water* in the *superficies* of them, after the same manner, as was before declared, concerning the Original of *Fountains*.

VII. *Of Joy there are divers Species.*

There are divers *species* of *Joy*, according as we consider the *Good* hapning to our selves, or the *Evil* to others. The first which offers it self is *Derision*, which hence hath its Original, *viz.* that we find some *Light Evil* in one, who is thought to deserve it. In which *Passion* there is mingled something of *Hatred*. As when we have an aversion to the said *Evil*; and yet nevertheless rejoyce to see it inflicted on him whom we think it but just it should fall upon. Those that are remarkable for any kind of deformity or defect of *Body*, are chiefly obnoxious to this *Passion*, as the *Gibbous* or *Bunch-backt*, *Goggle-Ey'd*, *Lame*, who, in regard they are not ignorant of their being an *Object* of contempt and derision from others, rejoyce to find others in as bad circumstances as themsemselves; it being to them a solace of that *Grief*, which they suffer from the Contumely objected against them; so that they take the least occasion given to insult over them, and sport themselves with their defects.

VIII. *What Satisfaction is.*

Satisfaction or *Acquiescence* in ones self, is a *Joy* of all the most grateful, which proceeds from the *Opinion* of *something done by us which we judge to be Good*. Whence they who give themselves to *Vertue* and *Honest Actions*, feel, I know not what Tranquillity, of *Soul*, and Quiet of *Conscience*, which is the most pure and sincere of all satisfactions, because they depend upon those things which are in our power.

IX. *What Favour.*

Favour is a Joy wherewith we are affected toward those that do well, and use their Free-will according to Reason. Since by a Natural Impulse, we are apt to *Love* those whom we judge to be Well-doers, tho' nothing of profit accrue to us thereby.

X. *What Gratitude.*

Gratitude is a certain joyful desire of doing well to those who have deserved well of us. This Affection is peculiar to Generous *Souls*, who are never insensible of *Kindnesses*, but strive always to be requiters of Benefits receiv'd.

XI. *What Glory.*

Glory is a Joy arising from Opinion or Hope, conceiv'd of obtaining praise among others. This *Passion* is founded upon *Self-love*, as when we value our selves according to the esteem we see set upon us by others.

CHAP. XIII.

Of Sadness.

I. *Sadness an Enemy to Man.*

GRIEF brings up the Rear of the Passions, the most common affection among Mortals, the Companion and Enemy of Joy. It seems to have been allotted by *Nature* for the Persecutor of *Mankind*, and lier in wait as well for *Soul* as *Body*. There is scarce any Sadness which does not transfer its force from the *Soul* upon the *Body*, and with one stroak hit two different things at once.

II. *The Definition of Sadness.*

For *Sadness is no other than a certain ungrateful Languor*, or *the Inconvenience which happens to the Soul, from the Evil or Defect which the Impressions of the Brain represent to it as its own.* Which Definition extends only to *Sensual Pains*, as they differ from *Intellectual*. For no doubt, but sometimes, there may be *Sadness* in the *Soul*, tho' all Cause be removed which excites *Corporal Pain*, as appears in those who have a Limb cut off, who are not only affected with *Sadness* upon the loss of the said *Member*, but also long after when they look upon themselves as maim'd *persons*, and depriv'd of a part which conduceth to the gaining of a *Livelihood*. But in regard these sorts of *Pain* are seldom found, which are produc'd by an *Action* of pure *Intellect*; and whatsoever happens to the *Soul*, so long at it is united to the *Body*, is depainted forth by *Imagination* in the *Brain*, We only here treat of *Sadness*, as it is a *Passion*.

III. *Whence Grief ariseth.*

And it arises from from an Opinion of an adherence of some *Evil* or *Default*; for the *Body* cannot be hurt, but the *Soul* must immediately be disturbed, and be sensible of a certain bitterness thereby. Tho' it sometimes happens, that we find our selves sad or dejected, when ignorant of any causes of the said dejection. As when the *Body* languishes, and is not able to perform its *functions*, when the *Heaven* is all over covered with *Clouds*, as it often happens in the *Winter-time*; because then the *Nerves* of the *Body* are not, as they us'd to be, agitated, and so remain, in a sort, immoveable.

IV. *The Internal Causes of Sadness.*

Sadness arises when the *Animal Spirits* are so dispos'd by the *Glandule* to the presence of an *Object* of *Sadness*, that they streighten and contract the *Orifices* of the *Heart* by the *Nervule* wherewith they are encompassed, and hinder the *Blood* from its copious entrance into it, and egress out of it. Whence it happens that the *Heart* hath very little of Ardour and Inflammation, the passages in the mean time remaining open, through which the *Chyle* is conveyed from the *Stomach* and Entrails into the common *Ocean*, which is the cause of Appetites being diminisht, unless *Hatred* supervening *Sadness*, which is oftentimes joyned to this *Passion*, closes and shuts them up.

V. *Various Effects of Sadness.*

Thereupon in *persons* affected with *Sadness*, the *Pulse* becomes weak and slow, and they seem to feel, as it were, Fetters about the *Heart*, which bind and restrain it like *Icicles*. Which frigidity being disperst through the rest of the *Body*, causes it to remain sluggish and unactive, and does also make those that labour under Sadness to grow *pale*, because by compressing the vessels of the *Heart*, it causes the *Blood* to flow the more slowly into the *Veins*; and so having less agitation than usual, it requires a less place to possess; so that betaking it

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it ſelf into larger *Veins* which are nearer to the *Heart*, it leaves the more remote; whereof thoſe that are diffus'd through the *Face* are more conſpicuous; and upon that occaſion they are rendred more pallid. Nor is the cauſe very different of thoſe *Tremours* which are incident to *perſons* affected with *ſadneſs*, in regard when the *Blood*, as hath been ſaid, is languidly deduc'd through the whole *Body*, it muſt needs be but ſlowly convey'd to the *Muſcles* of the *Arms* and *Legs*, ſo that the *Valvulæ* are not ſtraightly enough cloſed, which is the reaſon that the *Spirits*, ſwiftly taking their courſe through the *Connivent Oſtioles* of the *Muſcles*, produce *tremours* in the ſaid *members* of the *Body*.

VI. *How Tears are attendant upon Sadneſs.*

Tears, as they accompany *Joy*, ſo alſo ſometimes *Sadneſs*, and are produc'd, when upon the *Blood* being refrigerated by *Sadneſs*, the *Pores* of the *Eyes* are contracted, by reaſon of which compreſſion the *Vapours* proceeding from them are converted into *Water*; that is to ſay, becauſe their motion being retarded, their parts meet, and are ſo united one with another, that they end in *Tears*.

VII. *Evil, according as it is apprehended, excites various effects in us.*

As *Evil* is an Object of *Sadneſs*, ſo it produces various effects in us, according as we refer it to our ſelves or others. For an *Evil* offered by us under the notion of an *Evil*, when we conſider that we have committed it, excites *repentance*, which is ſo much the more bitter, in regard it depends upon our Free Will, and was in our power of committing or not committing that which ſo much aggrieves us. The *Remorſe* of *Conſcience* is a *Sadneſs* ariſing from a ſcruple or doubt, whether what we have done be good or not. In this *Paſſion*, *Dubitation* ought to be neceſſarily included; foraſmuch as if what we commit ſhould be manifeſtly known to be *Evil*, we ſhould refrain from committing it, ſince our *Will* is never carried on, but to thoſe things which are repreſented to us under ſome appearance of *Good*. And if that *Evil* which we commit, ſhould plainly appear to be an *Evil*, we ſhould then be toucht, not with a ſimple remorſe, but with downright *Repentance*, which is the ſevereſt of all *Paſſions*. We are therefore toucht with *remorſe*, becauſe we attempted a *work* before we made any doubt of it, or ſhook off the ſcruple of *Mind* which attended it.

VIII. *What Envy produces*

Envy is a *ſpecies* of *Sadneſs*, not ſimple, but mixt with *Hatred*; which proceeds from hence, namely, that we ſee a *Good* to befall others which we judge them unworthy of. This *Paſſion* extends not it ſelf to all ſorts of *Good*, but only thoſe which we call the *Goods* of *Fortune*. For thoſe things which are granted to us by *Nature*, ſeem to be above *Envy*. The *Envious* are for the moſt part of a *Livid Colour*, in regard *Sadneſs* operates upon the *Body* the ſame way as *Hatred*, cauſing *Choler*, which proceeds from the lowermoſt part of the *Liver*; as likewiſe *Melancholy* from the *Spleen*, to flow to the *Heart*, from whence diffus'd through the *Arteries* and *Veins*, they cauſe the parts of the *Blood* which is in the *Veins* to be leſs agitated; and this is ſufficient to induce a *Livid Colour* upon the *Countenance*, provided it be copious and intenſe enough.

IX. *What Faſtidie is.*

Faſtidie or *Loathing*, is another ſort of *Sadneſs* ariſing from the ſame cauſe from which *Joy* formerly aroſe; for we are of that *Humour*, that almoſt all things we poſſeſs, are valued by us as *good*, only for the time being, and are afterwards lookt upon as incommodious, which eſpecially appears in *Eating* and *Drinking*, which never pleaſe but ſo long as the *Appetite* prevails, and are diſtaſtful when the Appetite ceaſeth, and becauſe they then ceaſe to be grateful to the *Taſte*.

X. *The Effect of Commiſeration.*

Commiſeration is a *Sadneſs* mixt with *Benevolence* or *Love*, proceeding from the conſideration of ſome *Evil* which befalls thoſe *perſons* whom we think unworthy of it: And is in ſome ſo vehement, that it draws *Tears* from their *Eyes*, by reaſon that at that time, through the *Affection* of *Love*, a great quantity of *Blood* is propelled to the *Heart*, from whence many *Vapours* being emitted to the *Eyes*, and having their motion retarded with *cold*, are, as hath been ſeveral times already intimated, changed into *Tears*.

XI. *The Effects of Indignation.*

Indignation hath a great affinity with *Hatred* or *Averſion*, wherewith we are naturally ſtirr'd up againſt thoſe that do ill. It is very often join'd with *Envy* and *Commiſeration*, and the difference lies chiefly in the *Object*. Foraſmuch as we envy thoſe to whom any thing of good happens, and are fellow-ſufferers with thoſe that ſuffer ill undeſervingly. But our *Indignation* is againſt thoſe only who do good turns to thoſe that are unworthy of them.

XII. *Of Anger.*

Anger, which may be referred to *Indignation*, is *the Averſion againſt thoſe who have offered any Ill, or at leaſt have deſign'd any Injury to us*. This *Anger* is always attended by a deſire of *Revenge*, which is the moſt impetuous of all *Affections*; in regard the *Hatred* which is found in it, cauſes the *Bilious Blood*, which flows from the *Milt*, and from the little *Veins* of the *Liver* to undergo a very great *Agitation*; which *Blood* entring the *Heart*, ſtirs up an extraordinary *Heat*, which is far more rigid and vehement than that which proceeds from *Love* or *Sadneſs*.

XIII. *A Twofold Anger.*

There are two ſorts of *Anger*, one very *quick*, and ſoon breaking forth, and diſcloſing it ſelf in the *Countenance*; but this is of little effect, and with ſmall labour allay'd: The other is not ſo ſoon diſcharged, but inwardly afflicts and ſtings; and the effects of this are much more dangerous than thoſe of the former. To the *firſt*, thoſe are *Obnoxious*, who either *Love*, or are indued with a good *Nature*; by reaſon that this ſort of *Anger* proceeds not from *Hatred*, but from a ſuddain Averſion which haſtily ſeiſes them; becauſe thoſe things which they think of, fall not out in the ſame manner as they imagin; whence it happens, that as ſoon as they come to conſider that thoſe things which ſo moved them, ought not to have ſtirred them up to *Anger*, they are toucht with ſhame and Repentance, and condemn themſelves for their raſh and unſeaſonable *paſſion*; whereas thoſe that are affected with the other ſort of *Anger* are more to be fear'd, diſcovering no other *colour* in their *Face*, but a *pallid Hue*, in regard the *heat* being drawn back to the *Heart*, they reſerve themſelves for *revenge*, and think of nothing but the time of *Vengeance*, and thoſe circumſtances which lead thereunto: 'This is a *Vice* peculiar to *Perſons* of a *Baſe* and *Abject Spirit*.

XIV. *What Shame is, and Deſire.*

Shame is founded upon *Self-love*, which proceeds from Opinion or Fear of *Diſpraiſe*. *Deſire*, if

if it be more strictly inquired into, than commonly it is in *Schools*, is a certain sadness for a *Good* lost, and whereof there is no hope of recovery: For we are never afflicted with *Desire*, except for the loss of *Goods* sometime possest, and which we imagin so snatcht from us, as to be left without any hope of ever obtaining them again.

CHAP. XIV.

Whence the Natural Inclinations and Aversions of some Men arise.

I. *Various Inclinations are found in Men.*

HAving treated of those *Passions* of the *Soul* which are common to all *Men*, and which presuppose a Connexion of the *Body* and *Soul*; it remains that we say something of the *Inclinations* of some *Men*, which are peculiar to themselves, and which have the *Body* only for their *Principle*. For there are found in some *Men* certain *Affections*, which are by Nature implanted in them, by which they incline to some things with a wonderful Ardour of *Desire*; and are so abhorrent of others, as not to be able to indure the sight of them. So some *Men* have certain *Meats* in very great esteem and delight. Others on the contrary, have as much aversion to one thing or other: Many cannot endure the sight of a *Cat*, or the very presence of it in the same *Room*, tho' they see it not; some cannot abide the smell of *Roses*; and so for other things some have a *Love*, others an *Aversion*, of which neither can give any account.

II. *Antipathy and Sympathy are only words in the Schools.*

It is a common thing in *Schools* to have recourse to the words *Sympathy* and *Antipathy*, and thereby to pretend to give an account of *Passions*, which indeed they are wholly ignorant of, by saying that these things so happen, because there is a certain *Agreement* or *Enmity* in *Natural things*, by which they either *Love* or *Hate*. But this way of *Philosophizing* may be compared with a certain design or project for a piece of *Painting*; as if any one should go about to give directions with a *Pen* and *Ink*, how the *Sign* of a *City* were to be *painted*, in what part of the *Country* the *City* was situated, what *Posts* were chiefly possest by the *Besiegers*, where the *Enemies* planted their *Scaling-ladders* to get over the *Walls*, how the *Engines* broke the *Gates* asunder, where the *Pioneers* sprung their *Mines*, with what *Arms* the *Besieged* defended themselves, and where they made their *Sallies*; but after all should leave the whole Draught and Colouring to the Art of the *Painter*, yet nevertheless should take upon him to be the Author of this *Picture* of the *Siege*, to which he had contributed nothing but *Names*. So to assert that any thing is effected by a certain *Virtue*, and not to declare after what manner it is done, is to my apprehension the same thing as to confess ingenuously, that he is totally ignorant of the matter discours'd of.

III. *If a Corporeal Action be joyned to any Cogitation, we cannot remember the one without the other.*

Therefore some other way must be tried for the finding out of these *Occult Inclinations* or *Qualities* which are observed in some *Men*; which may easily be effected, if we consider but two *things*; First that there is such a connection of *Soul* and *Body*, that when once we have join'd any one *Corporeal Action* to any *thought*, never after any one of them manifests it self, but the other attends it; as we may observe in those persons, who being *sick*, have drunk up any Potion with much distast and reluctance, that they cannot afterwards feed upon any *Meat* or *Drink* that hath any thing of the relish of the said *Potion*; but that the *Stomach* must needs have an aversation to it; nay, cannot so much as remember that *Aversion*, but that the same *Savour*, which sometime offended the *Tongue*, must return into the *Mind*.

IV. *Sometimes it may be, that the same thing may be effected, yet the Actions of the Body not be the same.*

Secondly, observe that it is not always of necessity that the same *Actions* of the *Body* be joyn'd to the same *thoughts*. For those that speak *English* utter their conceptions by some certain *words* different from those by which the *French* express their *cogitations*, yet they both mean the same thing; for no otherwise is *DEUS* conceived by an English Man, under the word *GOD*, than by a French Man under the word *DIEU*, both of them understanding the same thing, tho' by two different appellations: For as often as an *English Man* hears the Name of *GOD*, he presently apprehends thereby an *Infinite*, *Eternal*, *Almighty Being*, &c. the same doth a *French Man* when the sound of the word *DIEU* comes to his *Ear*.

V. *Whence Natural Aversions arise.*

These things thus briefly noted, any one may easily give an account of all those matters which he finds particular either to himself or others. The *Aversions* which are observed in some *men*, against some things, hence proceed, namely that, in the beginning of their *Life*, they have been hurt or offended by them: So the smell of *Roses*, might possibly have given to an *Infant*, while yet in the *Cradle*, some great Offence, or a *Cat* might have affrighted him, without any ones taking notice thereof, or the Party's retaining it afterwards in *memory*. Some *Aversions* also are produced in us before we are *born*, since certain it is, that the *Motions* of the *Mother* have a very great influence upon the *Motions* of the *Child* in the *Womb*, so as that whatever is hurtful to the one, is also hurtful to the other. Thus *James* I. King of Great *Britain*, had so great an Aversion to drawn *Swords*, that he could not behold them without a world of *horror*, which is thought to have thus affected him, by reason that his Mother *Mary*, Queen of *Scots*, when she was great with *Child* of him, was frighted at the sight of a *Sword*, wherewith in her *Bed-Chamber*, and before her *Face*, in a barbarous manner, one of her *Courtiers* was stabb'd to *death*.

VI. *How it came to pass that K. James I. so much abhorred the sight of a drawn Sword.*

'Tis true, that it is no easie matter to determin the cause of this *King's Horror* upon the said occasion, since it is hard to conceive how the *Image* of the *thing* which was only transmitted through the *Eyes* to the *Mothers Glandule*, could light upon the *Glandule* of the *Infant*, whereas, as for other things, as the *Odour* of *Roses*, or the *Savour* of *Meat*, it may be aptly enough made out, since the *Odour* of the *Roses*, and the *Savour'd Aliment* might easily through the *Pores* of the *Mother*, reach to the *Infant*, since it is nourisht by the *Mother*, and both have a communion together by the *Navel String*. Yet it may be said that that Aversion in the *King*, might happen to him by the *Mothers Eyes*, because at the presence of so horrid an *Object*, a Notable Mutation might be made in the *Mothers Animal Spirits*, by which the *Infant* she carried in her *Womb* was offended,

offended, by reason of the mutual Relation between the *motions* of them both.

VII. *Imagination alone can beget such aversions.*

Besides, there is not an absolute Necessity that the *Object* should be always present to our *Senses*, for the exciting of any Passion in us, since that can be effected by *Imagination* alone. For an *Impression* through the *Arteries* of a *Woman* with *Child*, may arrive to a certain part of the *Birth*, and there produce some *Marks* thereof. Whereupon it happens, that those *Women* who transgress their *Nuptial Faith*, and prostitute themselves to other *Men*, many times bring forth *Children* like to their *Husbands*; namely, because the fear of being *surpriz'd* by the sudden arrival of their *Husbands*, causes them to have the Presence of their said *Husbands* perpetually represented to their *Imagination*, as hath been observ'd in the *9th Book* of our *Natural History*, in the *Chapter* of *Imagination*.

VIII. *Why of two Men beheld, we love one more than another.*

There seems yet to be a greater Difficulty, how to give an account, why of two *Persons*, whose *Merits*, are equally unknown, we incline to *Love* one more than another. But this will not be any great Miracle, when we seriously consider that the *Objects* which affect our *Senses*, move certain Parts of the *Brain*, by the help of the *Nerves*, and make Pleits, which, without any farther concern of the *Object*, vanish; yet so, as that the part in which they had been receiv'd, remains dispos'd for the receiving of Pleits from any other *Object*, which have any Similitude with the former. So when yet a *Child*, languishing with a long Distemper, and given over by the *Physicians*, I fell into the hands of a certain *Woman*, by whose Care and Industry recovering my *Health*, I contracted so intimate a Friendship with a *Son* of hers, that I could scarcely be divided from his Company, without much Regret and Impatience: Yea, after some Months, being carried home to my *Parents*, I perpetually languish'd with a desire of this my Little *Companion*; nor put I any end to my *Tears*, till such time as he was restored to my Society. And when a few *Months* after, it pleased *GOD* to take him out of this *Life*, I continued to bear a singular Affection towards all *Boys* whatsoever, that resembled him in *Countenance*; and to this very day preserve the same Affection to *Children* of the like Resemblance.

IX. *This Disposition is induc'd from Objects by the Senses, or from some other Cause.*

In like manner, when we Love any *Body* for any hidden Cause, it is more credible that it hence proceeds, namely that there is something in him, like to those things which were formerly in some beloved *Object*, tho' we know not what it is. And though doubtless that which thus allures our Affection, is oftner a *Vertue* than a *Vice*; yet nevertheless, in regard it may sometimes so happen, that it may be a *Vice*, no wise *Man* ought to indulge to this sort of Affection, till such time as he hath well weigh'd the Merit of that *Person*, with whose Presence or Concernment, he finds himself so affected. *DES CARTES*, when a *Child*, as he himself writes to *CHANUTE*, loved a little *Girl* of the same Age with himself, that was *Squint-Ey'd*; and by this means the *Impression*, which through the Sight was received in his *Brain*, was so joyned to the Impression which was also made in him, to move the Passion of *Love*, that even a long time after, as often as he lighted upon any who had the like sort of *Eyes*, he found himself propense to *Love* them above others, and for this very thing, because they had that *Imperfection*; yet did he not know that this was the Cause of his *Love*. On the contrary, from the time that revolving with himself, he apprehended this *Blemish* to be an occasion thereof, he was no longer affected by it.

CHAP. XV.

Of the Immortality of Human Mind, and of its State after Death.

I. *Human Mind being Spiritual, cannot be destroyed.*

THat *Human Mind* is uncapable of *Death* and *Destruction*, its *Nature* and *Functions* clearly demonstrate: For whereas it is evident from what hath been often said, that the *Soul* is a *Spiritual Essence* and separate from all *Matter*, it must consequently of necessity be free from all *Destruction* and *Corruption*; since nothing but what is *Concrete* and *Compound* can be separated, divided, or taken asunder. For *Destruction* is, as it were, a Separation, Dividing, or Parting asunder of those *Parts*, which before the said Destruction were held together, as it were, by a certain Link or Tye.

II. *Which is also made evident from its Functions.*

Nor do the *Functions* of the *Soul* less argue its *Incorruption*, as being Effected by no *Organ* of the *Body*, as is sufficiently made out almost throughout this whole *Work*; forasmuch as it *forms* and *proportions* the *Universal Natures* of things abstracted from *Matter*, which cannot be the Work of a *Corporeal Faculty*. For a *Power* or *Faculty* subjected to a *Material Organ*, receives the Qualities and Forms of things after a certain *Corporeal manner*. What therefore comprehends Forms in a *Spiritual manner*, uses no Instrument of the *Body*. Neither indeed are the *Principles* impress upon the *Mind*, or the Rudiments of *Cogitation* assign'd to our *Intellect*, *Mathematical Demonstrations*, or Certain and Fix'd *Judgments*, any *Corporeal Acts* or Productions of *Imagination*. But nothing Incommutable or perfectly Single; nothing *Eternal*, nothing *Universal* and Abstract is perceived by the Power of *Imagination*; whereas all *Bodies* are subject to *mutation*, *place*, and *time*.

III. *How Compounds and Simples are said, to lose their Existence.*

Now the better to support this Verity with *Reasons*, we must suppose, that of those *things* which perish or cease to be, some are *Simple*, and some *Compound*. The *Compound* are said to lose their *Existence*, when the Parts which concur to their Composition are separated from each other. As a *Man* is said to Cease, when *Soul* and *Body*, of which he is compos'd, are separated. Whereas the *Simple* can no other way cease to be, but by *Annihilation*, as they could no other way be produc'd but by *Creation*. And since *Creation*, as also *Annihilation*, are both beyond the power and ability of *Nature*, they can no way be destroy'd by any *Creature*. But it is evident, that the *Soul* is a thing purely *Simple*, since it is the only *Subject* that entertains *Cogitation* or *Thought*, together with the various Modes of *Cogitation*, and consequently the Capacity of being destroy'd, is Naturally repugnant to it.

IV. *Since the Body perishes not, much more must the Soul have an Existence*

And this will appear more evidently, by comparing the *Soul* with the *Body*. Certain it is, that the *Body* which gives place in dignity and perfection to the *Soul*, is not reduc'd to Nothing, when the *Soul* is separated from it: How therefore can the *Soul*, which is more noble and more perfect be

be thought to be annihilated when the *Body* is separated from it? Since indeed, no Reason can be brought for the duration of a *Material Substance*, which may not, by a more forcible Right, be apply'd to *Human Mind*. If we have recourse to the Evidence of *Sense* for the Consistence of *Body*, it cannot be maintain'd of all its Parts, since very many of them, into which it is resolv'd, are undiscernible to our *Senses*. Neither is the perception of our *Senses* so efficacious a means to demonstrate the *Existence* of *Bodies*, as the Reasons henceforth to be produc'd, are for asserting the *Immortality* of the *Soul*.

V. *Human Mind can be destroy'd by no Created Being.* If it be Objected, That *GOD* by his Power can *annihilate* all *Souls* whatsoever, and that it is through his Preservation alone that *Souls* are said to be *Immortal*. This we are ready to confess, as acknowledging that *GOD* alone is a *Being* wholly *Independent*, *Eternal*, *Necessary*, *&c.* and that there is nothing Existent in *Nature*, but only so long as he pleases. So that we have nothing now to do, but to make it out plainly, that *Human Mind* is of such a Nature and Quality, that it cannot be corrupted or destroy'd by any *Created Being*, which is a sufficient Ground for it to be call'd *Immortal*. For it being Undeniable, that *GOD* is all *Wise*, all *Good*, and all *Constant*; and *Human Soul*, the Noblest *Workmanship* of so great a *Maker*, and the *Image* of him: Who can imagin or believe, but that it must needs be far from the *Mind* of so Wise and Constant a *Maker* to Create so Glorious a *Work*, and afterwards to destroy it? True it is indeed, and not to be gainsaid, that *GOD* by his extraordinary Power, can destroy the *Human Soul* consider'd, according to its absolute *Esse* or *Being*: But it is repugnant to Reason, that he should destroy it by his ordinary Power, which is sufficient to make the *Soul* Immortal. For when we treat of the *Immortality* of the *Soul*, the Question is not, Whether *GOD*, by his Extraordinary Power can destroy it; but whether it can be destroy'd by *Natural Causes*, and by the ordinary Power of *GOD*.

VI. *The Corruption of the Soul, follows not from the Corruption of the Body.* Moreover, when a *Man* dies, *Death* happens to the *Body* upon this occasion only, namely, because some of its Parts are divided, and its *figure* changed. But the *division* of *Members*, or *change* of *Figure*, no way concern the *Mind*, in regard it is indivisible, and affected with no *Figure*. Who therefore can believe that the *Soul*, which is *Inextense*, can, for so slight a Cause, as is the Change of the *Body*, perish or be annihilated? In the next place, this sort of *Annihilation* hath not yet been found in *Nature*: Nor can it be made out by any *Argument* or *Example*, that *Substance* can perish. Wherefore, seeing that *Human Mind* is a Substance Independent of the *Body*, and not any way subject to the Mutations which are made in it, we conclude, that it may *Exist* separated from it, and by consequence, that it is *Immortal*.

VII. *There is no Cause capable to destroy a separate Soul.* As to what some say, That hence may indeed be inferr'd, that the *Soul* may possibly subsist separate from the *Body*; but that it will not last so Eternally. To this I Answer, that admitting one, the other must of necessity follow, in regard no Cause can be assign'd, which can destroy it in its state of Separation, since at time it is free from Matter, which alone is obnoxious to Change.

VIII. *Arguments of Lucretius against the Souls Immortality.* I know that there are many *Arguments* heap'd up by *LUCRETIUS* against the *Immortality* of the *Soul*. But they are of no weight against those who distinguish *Soul* from *Body*, and assign them contrary *Functions*. For if the *Soul* seem to be affected with the Diseases of the *Body*, to be disturb'd in *immoderate Drink*, *Epilepsy* and *Phrensie*, to be as it were lost in swouning *Fits*. This happens, because it is joyn'd to the *Body*, and makes use of it as its *Instrument* in performing most of its *Actions*. For as a *Scribe* furnish'd with a well-made *Pen* makes neat *Letters* or *Characters*; but that *Pen* being worn out with long use, he can no longer Cut his *Letters*, as before: So the *Soul* lighting upon a weak and infirm *Body*, ceaseth to perform its wonted *Office*, and remains as it were benum'd, sluggish and altogether unactive.

IX. *Diseases are not to be attributed to the Soul, but to the Body.* This change therefore is not to be imputed to the default of the *Soul*, but of the *Body*, by whose help, so long as it is tyed thereunto, it operates. So that in a *Phrensie* or *Lethargy*, it is not the *Soul* which is distemper'd, but the *Brain*: The *Instrument* fails, so the *Functions* are at a loss. In like manner *Drunkenness* is not to be attributed to the *Soul*, but to the *Body*; forasmuch as the *Brain* being unloaded of its *Vapours*, the *Soul* is recover'd and comes to it self again, and performs its *Offices*, as before.

X. *The State of the Soul, after its Departure from the Body is unknown.* But the state of the *Soul*, after its Departure from the *Body*, is altogether unknown to us, since it wholly depends upon *GODS* good Pleasure; nor can we know, but by Conjecture, how it will then use its *Faculties*. It is but a rash Conceit in those, who ascribe such Perfections to it, as they are uncertain of, and measure its Felicity by their groundless *Apprehension*, since without *Revelation* we can have no assurance thereof, except that it follows necessarily from its Nature: Only thus much we may know, *viz.* that it will be *Immortal*, by reason that since it is a *Substance* distinct from the *Body*, its destruction follows not from the dissolution of its *Mate*, so that it will always persevere in its *Nature*, that is, will always *Think*.

XI. *The Soul after Death, will not be sensible, nor remember.* We may likewise know, that it will have no commerce with *External Objects*, and that nothing of *Body* whatsoever can act upon it, because only its Union with the *Body* renders it capable of receiving the *Species* and *Actions* of *Objects*; so that it must needs be depriv'd of all *Sensibility*, and be destitute as well of *Memory*, as *Imagination*, in regard those things depend of the *Body*, and are chiefly conducible for the safeguard and knowing of the *State* thereof. Altho' it is not to be denied, but that it will perceive many *Objects*, by the force of *Intellect*, which will render their *Notions* more distinct and clear, than those which it had, when it was conversant in the *Body*. And there will be no Obstacle, but that the *Soul* may reproduce those *Notions* of things, which it had in this *Life*; by which it will come to pass, that it may the more easily remember them, forasmuch as it will occur to it, that once it had them.

XII. *The Soul will more clearly know Objects.* So that in regard no *Bodies* can any longer *act* upon it, there will be an evident consequence, that in that *State* and *Condition*, it will be absolute *Mistress* of its own *Thoughts*, and will not think, but

but of ſuch things as its own Will and Pleaſure ſhall be to think of; except by chance the *Almighty Maker* of All things, or other *Minds* or *Intelligences* with which it converſeth, create a new *Thought* in it. But ſo long as the *Soul* is ſeparated from the *Motions* of the *Body*, and nothing hinders, but it may remain employed in its own *Cogitations*, it will the more diligently, and with greater attention perceive things Objected to it, and will the more acutely advance in *Sciences*.

XIII. *Will every where accompanies the Mind.*

The like may be ſaid of the *Souls Will* and *Faculty* of diſpoſing it ſelf. By reaſon that when it ſhall be free from all *Commotions*, to which before, becauſe of its *Commerce* with the *Body*, it was obnoxious, it will with the greater liberty execute its own own *Affairs*, and will the more eaſily expel the Doubts, which are an Obſtacle to its *Determination*. Yet of it ſelf it will not be altogether free from Errour; becauſe in regard its *Intellect* is Finite, and penetrates not into all things, it may be deceiv'd in its *Perceptions*, tho' it be not ſo prone to *Errour* as before. Foraſmuch as being no longer poſſeſt by any *Prejudices*, and being free from *Affections*, it will the more eaſily gain this Point, not to be obliged to give aſſent to thoſe Things which it knows not clearly and diſtinctly, and by this means it will be leſs liable to Deception.

XIV. *It is Doubtful whether the Mind can, after Separation, move another Body.*

But it is not ſo apparently determin'd, Whether the *Mind* will, after the ſaid State of *Separation*, retain the Power which before it had of moving a *Body*; ſince indeed ſuch a Faculty doth not neceſſarily follow the Nature of a *Finite Being*, neither indeed is the ſaid *Faculty* granted to its *Will*, except ſo far as it hath pleas'd its *Maker*, that is, ſo far as he hath Decreed, that its *Moving Power* muſt depend upon his *Will*. But ſince it highly conduceth to the extolling the *Clemency* of *Almighty GOD*, that his *Works* ſhould be manifeſted to his *Creatures*; it is moſt probable, that he will conſerve this *Moving Power* in *Souls*, and give them Capacity to joyn their *Cogitations* at pleaſure to certain *Bodies*, and in ſuch a manner, as it ſhall deſire to *move* and *know* them.

XV. *The Soul, after Separation, will be capable of no Pain, as from the Body.*

As the *Mind* or *Soul* is all *Spirit*, it will no more after Separation be capable of *Joy* or *Pain*, according as they ſprung from the *Affections* of the *Body*; but only of *Joy* and *Pain*, which proceed from the *Intellect*. But if ever the *Mind* chances to ſuffer any thing from a *Corporeal thing*, it muſt be acknowledged, that it muſt conſequently of Neceſſity be United thereunto by the *Divine Power*, as it was upon *Earth*; ſo as that its *Cogitations* muſt be connex'd to the *Motions* of the ſaid *Body*, and according to the Meaſure of that Impulſe, it muſt ſuffer from it more or leſs. And upon this account it is not improbable, but that the *Fire* of *Hell* may act upon the *Body* of the *Damned*.

XVI. *Other things are hid from us, except what is revealed by Faith.*

Other things which are attributed to the *Soul*, after its *Departure* from the *Body*, are uncertain and altogether depend upon the *Goodneſs* and *Mercy* of *Almighty GOD*, whoſe *Arcana* or *Secret Counſels*, to go about to ſearch into, is both Raſh and Profane. Hence it is that our *Illuſtrious Philoſopher*, in his *Epiſtle* to the *Princeſs Elizabeth*, thus utters his *Mind* about the *State* of the *Soul* ſeparated from the *Body*. *But as to the State*, ſaith he, *of the Soul, after this Life, I know far leſs, than Sir* KENELM DIGBY: *For omitting thoſe things which Faith inſtructs us in, I confeſs indeed, that we may Conjecture many things by the meer Dint of Reaſon, upon which we may ſufficiently flatter our ſelves, and build mighty Hopes; but can gather nothing of Certainty.*

The

The Tenth Part
OF THE
INSTITUTION
OF
PHILOSOPHY.
VIZ.
ETHICKS,
Or, The Right way of Ordering the
LIFE of MAN.

A PREFATORY Diſcourſe.

Of the Dignity and Uſe of Ethicks.

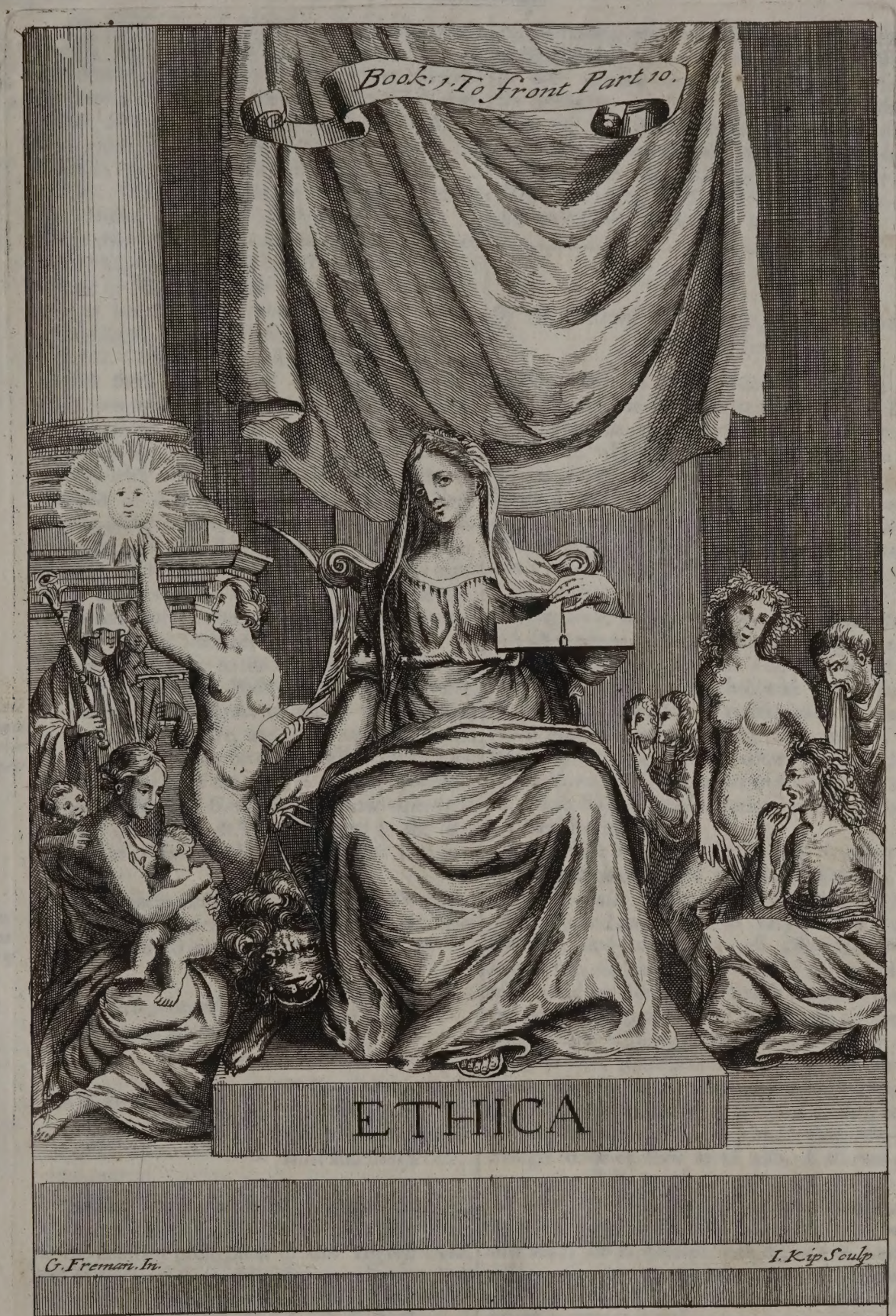
I. *The Dignity of* Ethicks *above other Sciences.*

THO' all *Philoſophy* was Invented for the Good of *Man*, and there is no part of it, which is not conducive to his *Natural Felicity*; yet doth ETHICKS deſervedly take the firſt place amongſt them all, as excelling them, both in Uſefulneſs and the Worthineſs of its End. For whatſoever other *Sciences* preſcribe, is only an Exerciſe and Accompliſhment of *Human Wit*; whereas the *Rules* of *Ethicks* are the *Remedies* of the *Soul*. *Logick* may pride her ſelf, for that her *Rules* direct and guide the Operations of the *Mind*, and by putting a difference between *Truth* and *Falſhood*, illuminate the *Underſtanding*, and prevent it from falling into *Errour*: But *Ethicks*, taking a higher flight, enquires into the Nature of what is *Good*, perſuades the purſuit of it, and having diſcover'd its Charms and Amiableneſs, allures *Mortals*, and enflames them with the *Love* of it. *Natural Philoſophy* may boaſt her ſearching into the *Eſſence* of *things*, and that by penetrating all the *Secrets* of the *World*, ſhe diſcerns thoſe hidden Properties that eſcape the moſt piercing *Eye*: But *Moral Philoſophy*, purſuing a more Noble Game, teaches us to ſubdue *Monſters*, to tame our *Paſſions*, and to be Victors over them. Let *Metaphyſicks* pleaſe her ſelf, that mounting up to *Heaven*, ſhe takes a view of *Intelligences* ſeparate from Matter, and by a daring Undertaking endeavours to diſcover the *Divine Majeſty*, *Power*, and *Unity*: Whilſt *Ethicks* with much more certainty diſplays the *Honour* that is due to *Angels*, and the *Worſhip* we owe to *GOD*; and by manifeſting to us that Supream Eſſence, as the firſt and chiefeſt of all *Beings*, doth not only put us in mind of the Obedience and Obſervance we owe to Him, but alſo forceth us to believe it moſt due to Him.

II. *It is a more excellent thing to purſue Good, than Truth.*

Who is there amongſt *Men*, that doth not prefer the *Love* of *Good* before the *Love of Truth*, and that would not rather embrace *Vertue*, than to pleaſe himſelf with the barren Knowledge of it? I confeſs it is a Noble thing to underſtand the *Affections* of *Material things*, and to ſearch out the *Nature* and *Properties* of all the ſorts of *Bodies* contained in the *Univerſe*: And yet who muſt not own, that it is far more glorious to put a Curb in the Mouth of *Concupiſcence*; and to undervalue all the gay *Bubbles*, which almoſt the *World* doth admire and doat upon? What can be imagin'd more great and wonderful, than to wreſtle againſt *Fawning Luſt*, and to retort the Darts of this *Domeſtick Enemy* upon himſelf? Is it not the expreſs *Character* of a great and ſublime *Soul*, to deſpiſe *Honour*, and to prefer a mean and low *Eſtate* before the *Pleaſures* of the *Court*, and the top of *Grandure*? All thoſe are the Effects of the good Counſel *Ethicks* gives us, and all the great Qualities we ſo much admire in *Men*, are but the product of her *Precepts*. And therefore the *Ancients* look'd upon that *Philoſophy* to be in a manner fruitleſs and to no purpoſe, which did not reſtrain our *Paſſions*; which did not put us upon the practice of *Vertue*, nor inſinuate into our *Minds* the wholſom *Laws of Nature*.

For



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III. *Ethicks cures the Diseases of the Soul.*

For as that Art of *Physick* is of no use, which cannot remove the *Disease* of *Mans Body*, or teach us how *Health* may be preserved or restored; so there is little or no advantage in that *Philosophy*, which doth not remove the *Maladies* of the *Mind*, and which like some *Trees* produceth nothing but *Leaves*, and pleaseth us only with the shade of *Words*. This commendation doth only belong to *Ethicks*, who like a *Mistress* of *Manners* informs *Men* what they ought to do; and is indeed the discipline and exercise of *Actions*, rather than of *Words* or *Notions*. If we take a view of the extent of her *Power*, it is she that first built *Cities*, and reduced *People* of different inclinations into *Societies*. *She* it is that instructs *States-men*, and teaches them the *Art* of *Governing*, shewing them how they may avoid the Envy of those that are governed. *She* it is that informs *Husbands*, how they are to behave themselves towards their *Wives*, with what care they are to mind the *Education* of their *Children*, and to govern both the one and the other, without injuring them. *She* it is that prescribes *Rules* to *Masters*, how to govern their *Servants*: In a word, there is no manner of *Life*, which is not directed by her advice, and which doth not borrow the *Rules* of *Governing* and *Obeying* from her.

IV. *What things are to be handled in this Tenth part.*

In order therefore to the more distinct discovery of the end of *Moral Philosophy*, it will be worth my pains in a few *Words*, to declare what I intend to treat of in this Part, and to lay open the whole Order and disposition of this Work. *First*, I intend to begin with the Nature of the *Summum Bonum* or *Highest Good*, and to shew wherein it precisely consists; next I shall proceed to the *Definition* of *Vertue*, which I distribute into two Parts.

V. *The division and Naturt of Vertue.*

One of these, named *Prudence*, is the *Directive*, she that giveth *Instruction*. The other are the chief *Doers*, employed in the making men vertuous.

The First whereof regards our selves, *viz.* { *Temperance* and *Fortitude.*

The latter regards others, *viz.* towards { *GOD*, and this is Godliness or Religion. *Justice* { *Men*, which is *Benevolence* and *Beneficence.*

Neither have I unadvisedly resolved upon this *Method*, forasmuch as the *Vertues* are a help to us, in the constant prosecution of this *Highest Good*, and as so many steps, whereby we raise our *Souls* to that which is *Worthy* and *Honest*. And having done this, I proceed to the *use of the Passions*, as being the Matter for the exercise of *Vertues*, and whereon they chiefly exert their Activity. To these I add a few Chapters of *Human Actions*, wherein is chiefly treated concerning the *Liberty of the Will*, whether it belong to *Man*, and whether it be consistent with the *Knowledge* and *Power* of *GOD*. Upon this occasion also, I enter upon the examination of the *Goodness* and *Evil* of *Human Actions*, and when they may be said to be conformable to right *Reason*, and when to thwart and cross the same. And *Last* of all, I shut up this discourse with the *Duties* of *Man* in *general*, and of a good *Citizen in particular*; in which two considerations, all that belongs to *Man* may be comprehended. I would also have the Reader to take notice, that in this Treatise I follow the Sentiments of *DES CARTES*: And tho' he hath writ but litle concerning *Moral Philosophy*, yet I have a mind to raise this structure upon the Foundation he hath laid, and from what he hath Writ concerning the *Soul of Man*, and the *Passions* to discover his Sense of *Moral Matters*.

CHAP. I.

Of the Nature of Ethicks, and the principal Parts thereof.

I. *The Certainty of Moral Philosophy.*

FOrasmuch as *ETHICKS* is a part of *Philosophy*, and the *Directrix* of *Human Life*, accordingly she derives her certainty from her own *Principles*; which do so much conduce to the obtaining of her end, that without their assistance, *Goodness* and *Vertue* can never be had. For as *PLATO* well observes, it is not by an impulse of *Nature* only, or by *Divine choice* and *favour*, that *Vertues* are acquired, and *Vices* banished; but it is necessary to call in *Science*, or rather the Art of *doing well*, to our assistance, that by her *Rules* and *Directions*, we may be exercised to good manners, and the inborn *Seeds* of *Vertue*, that lye buried in us, may be cherished and spring forth. And if at any time some have been known to arrive at the perfection of a *Vertuous Life*, without the *precepts of Ethicks*, yet must not we therefore deny her to be an *Art*; no more than we refuse the title of *Art* to *Physick*, tho' sometimes we may recover our Health without it.

II. *Tho' Ethicks in it self be very familiar, yet there are but few that agree in explaining of its Nature.*

Some think it is but a small thing to undertake the *Explications* of the *Precepts* of *Ethicks*, because the *Rules* conducing to the right deportment of our *Lives*, seem so very notorious and familiar, and common to all *Nations*. Who knows not, say they, that *Vertue* is to be had in esteem and practised; that *Parents* are to be obeyd and honour'd; and that *GOD*, whom all adore, is to be beloved above all things? It is proper indeed, to form *Rules* concerning things we are ignorant of; but as for Matters that are known to all *men*, these are best left to every ones owns *Sense* and *consideration*. For my part, I should be apt enough to be of their mind also, if all *men* did agree universally in the *Principles* and *dictates* of this *Art*, and if all without exception embraced, what seems evident to some. But alas, most *men* now adays are so infected with the itch of *contradiction*, that they many times start, and maintain new Opinions only to gratifie their wrangling and disputing *Humour*. As appears more particularly in this Matter before us, for tho' the name of *Moral Philosophy* be tost in the *mouths* of all *men*, yet there are but few that concur in their *Sense* about the nature of it; and notwithstanding it be very dangerous to mistake in the forming of our *Manners*, and the due regulating of our *Lives*, yet many chuse rather, to question the truth of *Moral Dictates*, than to want an opportunity of thwarting and contradicting the *Sentiments* of others, tho' never so clear and inconteſtable. But may I never be tainted with this Evil, whose aim only is, to pursue Truth, not concerning my self about what others teach, or what *Opinions* they espouse:

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My design only being to explain what *DES CARTES* hath left in writing about these *Matters*, and to pursue his sense and meaning.

III. *The Definition of Ethicks.* Wherefore from his *Method of discoursing aright*, I gather this definition of *Moral Philosophy*: viz. *that it is a right way or course of thinking, in order to the obtaining of Human Felicity.* Or *a Discipline directing man, in his voluntary Actions, so as to live well and happily.* In the name of *Discipline*, it agrees with the other parts of *Philosophy*, but is distinguisht from those *Arts*, which leave behind them some perceptible Matter, when the Action is over. For *Moral Philosophy* is not conversant about any *External* Matters, nor considers *Bodily Actions*; but is intirely employed and concern'd about the inward *Operations* of the *Will*, inasmuch as they are submitted to *Right Reason*, and by it directed to that which is *Good*. Wherefore to constitute its *difference* from other *Arts*, it is added *to live well and happily*; that from thence we might gather, that the *Mind* of *man* is perfected by *Moral Philosophy*, and directed by its precepts to act rightly, and comporting with reason.

IV. *The Object and end of Ethicks.* The *Object* of *Ethicks* is *right reason*, which is to be exercised towards all persons and things, and in all our *Actions*, and the several circumstances of them. Or if you will, it is *man* himself, inasmuch as he can and ought to be directed to an *Honest*, that is *Moral*, *Good*, according to certain *reason*. And the *end* of *Ethicks* is to perfect *man*, and make him happy. For if a *man* be steadily conformable to right *reason*, in all circumstances of *Persons*, *Things* and *Human Actions*, he is arrived to the highest top of his *Moral Perfection* and *Blessedness*.

V. *What Manners are.* The word *Ethicks*, signifies nothing but *Moral*, or that which concerns *Manners*; and accordingly *Ethicks* takes upon her to frame and direct our *Manners*; which are nothing else, but a *way or course of Living confirmed by custom*; or a certain accustomedness of *Acting*, or repeated *Human Actions*, which when they are conformable to *right reason*, are called *Good manners*; but if contrary to the same, *Vitious* and *Wicked*.

VI. *Ethicks does not so much consider External as Internal Actions.* And altho' many *Human Actions* are External, and such as cannot be performed without the help of the *Body*, as *Liberality*, which communicates her *Benefits* to others; *Justice* which gives to every one his due, and other such like which are free, and at the command of the *Will*: Yet are not these *Actions* primarily considered by *Moral Philosophy*, but secondarily only, so far as they are the effects of *Internal Actions*, and the product of the *Will*. For the *Duty* of *Liberality* doth not principally consist in the relieving of our *Friend*, but in the care and desire we have to assist him, which is the peculiar property of a generous and vertuous *Mind*. Neither can we suppose that the restoring of a *Pledge* or *Trust*, or the *paying* of a *Debt*, doth fulfil the whole requiring of *Justice*; but rather that *firm* purpose of the *Will*, whereby a *man* unalterably resolves to restore the *Trust* that is committed to him, and not *wrong* any by withholding their due from them. Wherefore *outward Actions* may be said to be the *Instruments* only, whereby the *Will* executes her *decrees*, and performs what she hath resolved upon. And tho' all particular *Actions be free*, as being performed or omitted according to the pleasure of the *Will*; yet it is not the concern of *Ethicks* to consider particular *Actions*, but only the *Actions* of the *Will* in general, to which it universally prescribes, that *GOD* is to be loved, *Vertue* to be embraced, and *Vice* to be avoided, *&c.*

VII. *Moral Philosophy is to be accounted amongst the practical Sciences.* From all which it is evident, that *Moral Philosophy* is not meerly *Speculative*, or consisting in the sole contemplation of *Manners*; but that it is to be reckoned amongst the *active Sciences*, its *work* and *business* being to *form our Manners*, *to instruct us to Vertue*, and *prescribe the Rules of well-doing*.

VIII. *Of the three parts of Moral Philosophy.* *Moral Philosophy* is commonly divided into three Parts, *viz.* into *Private*, *Domestick* and *Politick*. For *man* may be considered under various respects; *First*, as he is *a particular man*, that is, as he takes care of himself, and provides for his own *Good*: *Secondly*, as he is the *Master* of a *Family*, and performs the *Duties* incumbent on a *Master* or *Parent*; and *Lastly*, as he is concern'd in the *Government* of a *City*, or *Commonwealth*, and the giving *Laws* to others. All which diversities of *Offices* or *Duties*, are directed by so many several parts of *Moral Philosophy*. The *Private*, which some call *Monastick* or *Solitary*, is that part of *Ethicks*, which gives *Rules* how *men* in their singular State ought to behave themselves: The *Domestick* or *Oeconomical*, is that which lays down *Precepts*, how *Families* may be rightly ordered: And the *Political* teaches and instructs us in whatsoever conduceth to the good of *Societies*, and how both *Magistrates* and *Subjects*, are to behave themselves in their several *Stations*: For seeing that *man* stands in need of the *Help* and assistance of others, as well with reference to those things which are the necessaries of *Life*, as those which are the comforts and conveniences of it; he is assisted in those things which are necessary to Life by his *Family*, and by the *Society* or *Commonwealth*, with that which conduceth to his safety and well being.

IX. *The Domestick and Political part of Ethicks are reducible to the private.* But whatsoever *Modern Philosophers* may talk of this distribution of *Ethicks*, it seems clear to me, that the two latter parts of *Moral Philosophy* are contained in the *former*, and that if a *man* be only instructed in good *Manners*, this is sufficient to qualifie him, for the well and happy governing of his *House* or *Commonwealth*. For it is still a *Private man*, that manageth matters, whether in a *Family* or *Commonwealth*, and who certainly will be by so much the more fitted to discharge his *Duty* and *Trust* in either, by how much greater command he hath got over his *Passions*, and the more eminent he is in *Vertue*. For the *Vertue* of a *Private person*, doth not differ from that of a *publick* and *Political*; no more than the *Felicity* of the one, differs from that of the other. For whatsoever the *Private* part of *Ethicks* professeth, the same is with equal Right contained in the two others, *viz.* the *Science* of *Life*, besides which nothing is taught, or contained in the *Oeconomical* and *Political*. Neither can we assign any other difference betwixt them than there is, in the several *Pipes* of *Wind-Engines* or *Instruments*, in which one and the same *Wind* produceth several *Sounds*. In like manner all *men* receive from the *Private* part of *Moral Philosophy*, the *Rules* of living well and conformably to *reason*,

ſon, notwithſtanding that as the greater *Pipes* of an *Organs* yield a deeper *Sound*, ſo thoſe who are in high and honourable places in the *Commonwealth*, may have a more large field wherein to exerciſe their Vertues, and more ample matter, of giving illuſtrious and ſignal inſtances of their *Firm Probity*.

CHAP. II.

What Good is, and how and why the ſame is deſired.

I. *Nothing is Good but with reference to another.*

BEfore we proceed to explain the nature of *Good*, and to diſcover that which is the deſire and delight of all *men*; we are to take notice, that a thing conſidered in it ſelf, cannot be ſaid to be either *Good* or *Evil*, but only with reference to ſome other *thing*, to which it is conducive to attain that which it purſues, or on the contrary. Thus *Venom* is good and wholeſome to a *Serpent*; but hurtful and deſtructve to *man*. And therefore, if we except GOD *Almighty* only, who doth *good* to all, and preſerves the *Being* of every *thing*; there is nothing in the *World*, which in a different reſpect may not be accounted *Good* and *Evil*. But this being ſo, a difficulty ſeems to ariſe, how then we may come to know and perceive that which is *Good*, and how to diſtinguiſh it from that which is *Evil*.

II. *Good cannot be defined with the reference it hath to our Appetite or deſire.*

Some define the *Eſſence* of *Good* by our *inborn Propenſity*, or *Inclination*; as ſuppoſing that to be *Good* which excites our deſire, and allures us to embrace and purſue it. But theſe according to my *Judgment*, do not exactly enough lay open the nature of *Good*. For that *Inclination* whereby we are carried out to deſire that which is *Good*, ſuppoſeth it to be ſomething that is ſuitable to our *Nature*, ſo that the thing muſt be endued with the formal reaſon of *Goodneſs*, before ever it can move our *Appetite*. For *Appetibility* or *deſirableneſs*, is nothing elſe but an *Affection* or *Property* of that which is *Good*, and which flows from its *Eſſence*. Now it is inconſiſtent with the *Rules* of true *Definition*, to make the proprieties of things to conſtitute the natures of them.

III. *The true Definition of Good.*

Good thefore may better be defined thus, *viz. that which is acceptable and ſuitable to every one.* And that this is a true *Definition*, will appear by an enumeration of the ſeveral general heads of *Good things*; for all *Good* is comprehended under one of the three heads of *Honeſt*, *Pleaſant* or *Profitable*. An *Honeſt Good* is that which is agreeable to *right reaſon*, and is deſired for its own ſake: As *Vertue*, *Piety*, *to love Good*, *to honour ones Parents*, *to relieve the Poor*, *to curb the luſts of the Fleſh*. *Pleaſant Good* is that which is deſired for *delights* ſake (yet without thwarting the *Honeſt Good* and *Right Reaſon*) as *Muſick delights the Ear*, *a curious Picture the Eye*, *and the conſcience of Good deeds*, *does afford innocent pleaſure to Mind or Body*. *Profitable Good* is that which is *Good*, in order to ſome other thing, for the acquiring whereof it is deſired, as *Mony*, *Riches*, *&c.* But not one of all theſe is called *Good*, ſave only in reference to its being ſuitable, or agreeable to ſome other thing. The reaſon whereof is this, becauſe the operation of the *Underſtanding*, muſt go before the *Act* of the *Will*; and therefore it is neceſſary that the *Object* be *firſt* known to be agreeable to a reaſonable *Nature*, before that the *Will* can be carried out towards it.

IV. *There are two ſorts of Appetites.*

Now it will be eaſie to ſhew how, and in what manner things are carried out towards that which is *Good*, that is to the deſire of that which is agreeable to, and convenient for them, if we conſider the two *Appetites* in *Man*, whereof the one is call'd *Innate*, the other *Elicit*: The *Innate Appetite* is an inborn inclination, whereby a thing is carried towards that which is convenient for, and acceptable to it. Thus the *Peripateticks* generally hold, that the *Fire* by a natural propenſity tends upwards; and that *Plants* attract a ſuitable *Aliment* out of the *Earth*. Tho' indeed this ſeems very difficult to conceive, that things utterly devoid of *Senſe* and *Knowledge* ſhould deſire any thing, or be endued with any propenſity. We cannot deny, but that in things of this nature, there are ſome certain *Laws* of *Motion*, appointed by the *Author* of *Nature*, which may be ſaid to be a kind of inward propenſions; as that every *motion* affects to purſue a right *Line*; but we yet muſt have a care, not to attribute any *Appetites* or *Inclinations* to things, when we ſearch into their more hidden *Qualities*, for this would be to confound the *Attributes* of the moſt different things. Wherefore *Appetite* is only to be attributed to *Man*, it being an *Act* of the *Will*, whereby upon previous *Underſtanding*, it is carried out to that which is convenient for it.

V. *In what ſenſe Inanimate things may be ſaid to deſire things.*

Wherefore when I ſay, that *Inanimate things* have an *Appetite*, I would not be ſo underſtood, as if I did attribute any *Knowledge* to them, by which they deſire things grateful, and avoid the contrary (for *Knowledge* is no where but in the *Mind*) but only that by an infallible neceſſity they follow the guidance of the *Divine Reaſon*, and indiſpenſably obey his *Will*; in like manner, as an *Arrow* by a skilful *Archer* is guided to the mark, with out having any *Knowledge* or *Perception* thereof: *Inanimate things* therefore purſue that which is *Good* by a natural impulſe, and reach it by means of *Local motion*, which the great *Creator* of the *Univerſe* hath furniſht them with. *Man* alone deſires *Good* from a preceding *Knowledge*, becauſe he only is poſſeſt of a *Soul*, whoſe peculiar nature it is to *Perceive*, *Will* and *Imagin*.

VI. *How it comes to paſs that Man ſometimes deſires Evil.*

But it may be enquired, ſeeing that *Man* doth not purſue that which is *Good*, without a foregoing knowledge of it, how it comes to paſs, that he ſometimes goes in queſt of the contrary, that is, *Evil*? To which I anſwer, that *Evil* is never deſired by *Man*; but whatſoever his deſire is carried out after, the ſame is always propoſed to him, under the likeneſs and appearance of *Good*. For tho' it may be, that which he hankers after, be contrary to *Reaſon*, and the *Law* of *GOD*; yet is the ſame always repreſented to him as ſome *Pleaſurable* or *Profitable Good*, and is conſequently allured to it, under the notion of its being ſuitable to him.

VII. *Why all Men, none excepted, deſire Good.*

It will be ſufficient for the explication of the *Nature* of *Good*, only to diſcover the cauſe, why all *Men* promiſcuouſly deſire that which is *Good*, and are byaſt towards it, by an inborn propenſity. To do this will be very obvious, if we remember, that *GOD* is the ſupreme *Good*, comprehending all

the *Perfections* that can be conceived by the *Mind* of *Man*. Wherefore when any other *Good* is repreſented to us, we deſire it upon no other account, but as we apprehend it to partake of the *Divine Goodneſs*, becauſe by its *Eſſence* and *Exiſtence* it bears ſome kind of Reſemblance with him. And hence it is that no *Reſt* can be found, either in the Poſſeſſion of *Good things*, or in the *Contemplation* of *Truth*; becauſe nothing created can equal the *Idea* we have of *Good* and *Truth*: tho' in the mean time we ſnatch at ſome imperfect *Images* and *Glances* of it, whereby our *Love* is inflamed to attain the *Supream Good*. This *Affection* alſo is ſometimes kindled in us from the Diverſity of *Objects*, as being apt to imagin that we make ſome approaches to the infinity of that *Higheſt Good*, by enquiring into the Nature of new *Objects*, and by extending the Bounds of our *Knowledge* and *Enjoyments*. Accordingly it happens ſometimes that *Covetous Miſers*, quitting their niggardly *Companions*, frequent the company of *Liberal Perſons*; and that ſuch as are *Sad*, keep company with thoſe that are *Merry* and *Jovial*; and thoſe that are *Angry* and *Froward*, with perſons of *Meek* and *Quiet Spirits*; as being ſenſible of an inſufficiency in themſelves, and that they ſtand in need of the help of others towards the obtaining of their proper *Good*.

VIII. *In every Deſire there is ſome appearance of the Supream Good.*

Now in all theſe there is ſomewhat of a tendency towards that *Higheſt Good:* for *Ambition* doth not proceed from an Inborn deſire of *Honour*; nor doth the concupiſcence of *Love* proceed from *Nature*, but from a Pravity of *Manners*, whilſt they are panting after that Immenſe *Good*, and affect the Poſſeſſion of that which is infinite. For the *deſire* of that which is *Good*, is, as it were, the Great *Artificer* that endeavours to make *Created Beings* conformable to their firſt *Principle* and like unto him.

CHAP. III.

What the Higheſt Good is.

I. *All Men aſpire after Happineſs.*

THERE is nothing ſticks ſo cloſe to the *mind* of *Man* as the deſire of *Bleſſedneſs*, and tho' ſometimes we can hardly obtain or reach it, yet we are ſtill in purſuit of it. For all the other *motions* of our *Mind* vaniſh away by degrees, and in proceſs of time are leſſened and weakned. For we are not always taken with the ſplendor of *Honours*, or inflamed with the love of *Riches*; and *Pleaſure* or Voluptuouſneſs at laſt loſeth all its *charms*, whereby it formerly captivated us, ſo that we loath the *Objects* we before panted after. But the deſire of *Happineſs* admits of no viciſſitude, but as long as we breathe, or our *Hearts* do beat, excites us to the purſuit of it.

II. *What the Higheſt Good is.*

This is that in which all *People* do agree, that they deſire to be *Happy*; and how greatly ſoever they may differ in their *Tempers* and *Inclinations*, yet they all unite in this *Paſſion*, that they all affect to be happy. And accordingly the *Ancients* called the *Higheſt Good* the *laſt of all deſirable things*; foraſmuch as the ſaid *Good* is every way perfect and abſolute, which being once attained, there remains nothing further to be deſired. The SUPREAM GOOD therefore is that Mark which all our *Words* and *Deeds* tend to; and as *Seafaring-men*, direct their *Eyes* to the *Pole Star*, ſo likewiſe is our *Soul* to be directed to ſome end, to which all our conſults and deliberations of *living* well, and *acting* aright muſt tend.

III. *Why there be ſo few that know it.*

Tho' almoſt all *Philoſophers* have written concerning the *Higheſt Good*, and have left great *Volumes* on that *ſubject* to Poſterity, yet were they never more miſtaken in any thing, than they have been in that point, inſomuch that I dare affirm, that excepting only a few, they were never more unhappy in any of their undertakings than in this reſearch after the true *Nature* of *Human Felicity*. I conceive that their miſtake herein was cauſed by reaſon of their not duely conſidering what properly belongs to *Man*, or for want of accurately diſtinguiſhing between the *functions* of the *Mind*, and the *motions* of the *Body*; by which means, ſlighting the *Inhabitant*, they only had regard to his *Home* or *Lodging*.

IV. *The Supream Good defined.*

The *Higheſt Good* therefore of this Life, is that *which makes Man, here on Earth, moſt perfect and happy*. And therefore for its ſake only all other *things* are deſired, whereas the *Supream Good* is deſired for its own ſake. We ſeem to expreſs, at leaſt, a kind of confuſed *knowledge* of this *Good*, when we prefer one thing before another: for when-ever we chooſe one *thing* rather than another, we always ſuppoſe the one to be *Better*: now that only is ſo which comes neareſt to the *Beſt*. So that it appears we have an indelible notion of the Beſt, that is, *Supream Good* impreſt on our *Minds*.

V. *The Differing Opinions of the Antients concerning the Nature of the Higheſt Good.*

Some have defined the end of all our *Actions* to be *Pleaſure*, the deſire whereof is born with us, as well as the averſation of *Pain*; of which number was ARISTIPPUS the Philoſopher, and the CYRENAICKS. Others determined *Bleſſedneſs* to conſiſt in the enjoyment of a *concourſe* of all *Good Things*; and that no *Man* was happy, that did not poſſeſs the affluence of them all. And accordingly, for to conſtitute their *Happy Man*, they require that he have *Friends* to adviſe and aſſiſt him; that he have *Riches* for neceſſaries and convenience; *Power*, whereby he may command others, and make them ſerviceable to him; *Nobility*, to make him conſpicuous and eminent; yea, and *Beauty* too, with a *fruitful Wife*, and wel-mannered and witty *Children*. But, as I ſaid before, I ſuppoſe that theſe *Philoſophers*, who placed *Happineſs* in theſe things, never well conſidered the Nature of *Man*, nor what belongs to his *Mind*, and what to his *Body*. For had they lookt upon the *Mind*, as they ought, to have been the chief and principal part in *Man*, they would never have placed his *Felicity* and ſatisfaction in things that gratifie his *outward Part*, ſeeing that true ſatisfaction appertains only to his *Rational and inward Part*. But foraſmuch as the diſpute amongſt *Philoſophers* is not ſo much about the *Nature* of *Felicity*, as the *Cauſes* of it, that is, the means which lead to it; it ſhall be our care chiefly to diſcover, whence *Happineſs* doth ariſe, and what that *Supream Good* is, by the enjoyment whereof we are made *Happy*.

To the Worship-
full Captaine
William Wallis
of St. Martins in
the Fields in the
County of Midlesex
This Plate is humbly
Dedicated by Richard Blome.

CHAP. IV.

That the Good Things of the Body conduce nothing to Mans Happineſs.

I. *Ariſtotle ranks Health amongſt the moſt conſiderable Good things that concur to Mans Happineſs.*

THE *Good things* of the *Body* are commonly reduced to theſe three, *viz. Health, Beauty, Pleaſure*; in the enjoyment whereof we are commonly eſteemed *happy*. For if we conſult ARISTOTLE, he will tell us, that *Health* is as great a *Good* to us, as a *calm Sea* is to the *Birds* called *Halcyons*; who, when the Face of the *Sea* is ſmooth, and not wrinkled with *Winds*, with great eaſe and delight diſpatch their affairs, ſit brooding upon their *Eggs*, hatch their *Young*, cheriſh and feed them: and that much the ſame pleaſure and eaſe attends thoſe that have a firm and healthful *Conſtitution* of *Body*, whereby they with chearfulneſs exert all the functions of *Life*, and with a ready activity diſcharge all the Offices incumbent upon them. For when the *Body* is ſick and weak, who knows not that the *Briſkneſs* and activity of *Man* languiſheth, and that the very perceptions of his *Senſes* prove burthenſome and irkſome unto him? His *Ears* loath the ſweeteſt *Muſick*, his *Sight* is tired with the moſt *Beautiful* and charming *Objects*, the *Conferences* of his *Friends* prove tedious, and by an utter diſlike of all things, he ſometimes becomes intolerable, even to himſelf.

II. *If Health were the peculiar Good of Man, Beaſts would excel him.*

But, notwithſtanding all this, far be it from us to conſtitute the *Good* of *Man* in ſo mean a gift of *Nature*, and to make his *Felicity* to depend on his *Body*. For if we place the chiefeſt *Good* in a due ſtate of the *Body*, ſhall we not make *Beaſts* more happy than *Man*, who generally enjoy a more firm and vigorous health, and more perfect *Senſes*? Whatſoever conduceth to the *Happineſs* of *Man*, muſt be peculiar to him, and not common to him with the *Brutes*. Beſides, the things that conſtitute the *Higheſt Good*, muſt be *ſtable* and unmoveable; but what is more weak and tottering than *Health*, which is overturn'd with the leaſt fit of *Sickneſs*, and which as years encreaſe upon us, decreaſeth continually? That which is not in our *Power*, but depends on another for its ſubſiſtence, doth not deſerve the name of *Good*. Do'nt we ſee frequently that the moſt Learned and moſt accompliſht *Men* are the moſt weak and ſickly? And that the things which promote and aſſiſt the *mind*, are hurtful to the *Body*? Are not *Studies*, which inform and enlighten the *Mind*, and inflame the Will, prejudicial to the good *Temperament* and State of our *Bodies* which they alter and weaken?

III. *Beauty is no part of Mans Happineſs.*

And the ſame judgment muſt be made of *Beauty*, becauſe of its Frailty, and ſhort continuance. For what ſeaſon of the *Year* can be named, that doth not conſpire to the defacing of it? The *Winters* Cold by driving the *Heat* inwards, much abates the florid colour of the *Face*, whilſt the *Summers Heat* tans the *Skin*, wherein *Beauty* hath its peculiar reſidence, and ſits exalted as on her Throne. But ſuppoſe we this fading *Flower* to be perpetual, and exempt from the *Power* of the diſtemperature of *Seaſons* or Weather, yet after all, we ſhall never be able to make it a part of the *Higheſt Good*, ſeeing it brings nothing but trouble along with it, and diſturbs the peace of thoſe that are moſt poſſeſt of it with continual ſollicitude. How vexatiouſly ſollicitous are *Young Men* and *Maids* to appear *Beautiful* to the *Eyes* of *Spectators*? What pains and inconveniencies do they not undergo, to preſerve this *fading Flower*? How many *hours* do they ſpend in Curling and Combing their *Hair*, and other *Trimmings*, and neglect the improvement and good ſtate of their *Minds*, to adorn and deck their *Bodies*? Nothing can be eſteemed *Good*, but what is conducive to *Vertue*; but who is ſo blinded with the *Charms* of *Beauty*, to aſſert that it is any way helpful or conducive to *Vertue* and *Honeſty*? When on the contrary it is apparent that it is the greateſt allurement to *Sin*, and furniſheth the ſtrongeſt incentives to *Luſt* and Concupiſcence? A *Woman* that ſets many *Hearts* on *fire*, is in no ſmall danger of being fired her ſelf: And it is but ſeldom that we find exact Chaſtity and great *Beauty* to go hand in hand together; and there is but too juſt reaſon to ſuſpect, that ſhe who is too induſtrious to pleaſe others, is not free from impure deſires her ſelf. Wherefore conclude we, that *Beauty* cannot be ranked amongſt the *Good things* that conſtitute *Human Felicity*, as well becauſe it is ſo brittle and fading, as becauſe it gives occaſion to promote *Vice* and advance Folly.

IV. *Bodily Pleaſure cannot make Man happy.*

But there are none that more abuſe the name of the *Higheſt Good*, than thoſe who place it in *Pleaſure*, and take its height from *ſenſual delectation*. not that I ſuppoſe this to have been the opinion of EPICURUS, as moſt do, ſince I am perſwaded that his *Precepts* were *Vertuous* and *Good*, and that he made uſe of the word *Pleaſure*, not to advance *Voluptuouſneſs*, but to promote *Vertue*, as I have elſewhere ſhewed at large. Wherefore I do here contend with them only, who owning nothing in *Man* beſides his *Body*, ſuppoſe that his *happineſs* conſiſts in abounding with *Pleaſure*, and that he is then *Bleſſed* when every part of him hath its ſhare of *joy* and *delectation*.

V. *They that conſtitute the Felicity of Man in Bodily Pleaſure, do level him with the Beaſts.*

But theſe may be eaſily convinc'd of their error, by putting them in *Mind*, that by ſetting this Eſtimate upon *Mans Happineſs*, they level him with the *Beaſts*, and aſſign to him no greater *Good* than *Swine* themſelves do enjoy. Nothing can enter the Conſtitution of the *Supream Good*, but what is *Eternal*, and which affects the *Soul* in ſuch a manner, as to be hurtful or prejudicial to no *Body*, and never cauſing wearineſs or loathing. Whereas *Pleaſure* is inconſtant, and ſoon languiſheth, and is extinguiſht when it delights moſt. Whatſoever is the true *Good* of *Man*, doth not thwart any other *Good*, but is advantageous to *Vertue*, and to his *Body* and *Soul*; whereas there is no greater *Enemy* to *Prudence* than *Pleaſure*; nothing that more overcaſts the *Mind*, and fills it with diſquiet and ignorance; being always Raſh and Precipitant, impatient of *Advice* or *Counſel*, and not ſo much the effect of *Choice*, as of a ſuddain attack and onſet. What agreement can there be betwixt *Human Felicity* and ſuch a *Good* as this? The thing muſt be *Immortal* and *Eternal*, that can make an *Immortal Soul Happy*.

VI. *Pleaſure is common to Good and Bad Men.*

Beſides, how can the *Higheſt Good* of *Man* conſiſt in that which is common to *Good* and *Bad*, to the *Criminal* as well as the *Innocent*; that which enticeth *Men* from *Vertue*, and *clouds* their *Judgment*; the affluence whereof clogs and breeds a loathing, and commonly ends in *Sadneſs* and *Repentance*?

pentance? Now that all theſe things may be truly affirmed of *Pleaſure*, is evident to every one that conſiders the Nature of it.

CHAP. V.

External Good Things are not the Good of Man.

I. *The Good things of Fortune are not in our Power, and therefore do not belong to us.*

FOraſmuch as *Suitableneſs* conſtitutes the *Nature* of *Good*, and that we always deſire that which is moſt agreeable to our *Nature*, we do abuſe our *innate Faculties*, when-ever we deſire things that are not ſuitable to us, or which are not in our own *Power*: which they evidently ſeem to be guilty of, who rank outward *Goods* amongſt thoſe *Good things* that are conducive to the *Happineſs* of *Man*. For ſuch as theſe purſue Happineſs in matters that are foreign to them, and the Acquiſition whereof is not in their own *Power*. Whereas what can be imagined more fooliſh than to proſecute a *Precarious Felicity*, and to borrow the means and helps of a *Happy State* from foreign things? Who ever acquired *Riches*, *Renown* or *Nobility* when he pleaſed? they being Largeſſes of *Fortune*, which ſhe gives, and takes away by chance, and at random.

II. *Riches are frequently a Mans greateſt Enemy, and moſt prejudicial to his Peace and Quiet.*

You'l ſay that *Riches* are neceſſary to a *Happy Life*, foraſmuch as they furniſh us with many *comforts* and *conveniencies*. But for all this, I ſhall never admit any thing to enter the conſtitution of the *Higheſt Good*, except it be firſt demonſtrated to me to be *Good* in it ſelf, or that it be in the poſſeſſion of ſuch a one, who can *vertuouſly* make uſe of it. But where is he that *underſtands* the true value and worth of things, and eſtimates them accordingly? Where is the *Rich Man* that is not puſt up with his *Riches*, that doth not deſpiſe his Inferiors, and doth not ſcorn their company? *Riches* indeed may conduce to Pomp and Splendor, but not to that ſtate which we require in a *Wiſe Man*, *viz.* a conſtant calm and ſedateneſs of *Mind*. For with what racking ſollicitude are they tormented in the acquiring of them? What *care*, what *pains* do they take to preſerve them when got? So that they may truly be ſaid not to poſſeſs their *Riches*, but to be poſſeſſed by them. Beſides, the poſſeſſion and enjoyment of *Good* muſt needs fill and ſatisfie the *Soul*: But where is the *Rich Man* that is content with his Condition, ſeeing that they are never ſatiated with *Gold*; and that all their acquiſitions ſerve but to enlarge their *Deſires*, and render them inſatiable? Laſtly, we find nothing more frequent and obvious than that *Riches* do debauch *men*, and corrupt their *manners*, and tempt the beſt *Natures*, ſometimes, to the worſt of *Vices*. It was *Riches*, far more powerful than *Swords* or *Darts*, that broke and vanquiſht the *Roman Vertues*, and made Slaves of them, who had maſtered the whole *World*. The *Romans* were every where *Conquerors* whilſt they were poor, neither could any thing ſtand before them; but were conquered and trod upon as ſoon as they began to wallow in *Riches*.

III. *Riches cannot make Men happy.*

Moreover, that which is the *Higheſt Good* muſt needs *accompliſh and Bleſs Man in the higheſt degree*, it muſt needs be conſtant and permanent, be deſirable for it ſelf, belong to *Good Men* alone, and exclude all *Evil*; but nothing of all theſe can be found in *Riches*. For *Riches* are not deſired for themſelves, but for the ornament and convenience of *Life*; they are more frequently poſſeſt by *Bad*, than *Good Men*, as daily experience ſheweth; they are the *Cheriſhers* and *Fomenters* of *Vice*; they do not bar or keep off *Evil*, they do not fill the deſire, and they often make a man infamous and corrupt him, inſtead of making him better.

IV. *Honour is a Fickle Good, and depending of another.*

Neither can *Honour*, with any greater Right, lay claim to the title of *Good*, as wanting ſtability and permanence, and any other ſubſiſtence but what they have in the opinion of *men*. For they do not long follow the ſame *perſon*, but ſhift continually, and imitate the inconſtancy of the *People*, whoſe breath they depend upon. Do not *Hiſtories* furniſh us with Examples of thoſe who from weilding a *Scepter*, have been reduc'd to hold the *Plough*; and who from a ſtate wherein they were raiſed, not only above the Heads of others, but above the *Laws* themſelves, were forced within Bounds, and had their extravagant Power retrencht? Did we never hear of SEJANUS, that moſt famous *Roman Conſul*, who was the *Emperors Deputy* and *Lieutenant General*, and whom TIBERIUS called his Friend, how upon a Letter from that *Emperor* to the *Senate* he was caſt into *Priſon*, and ignominiouſly treated, being abhorred and flouted at by thoſe, who worſhipt him but a while before? And ſhall we not conclude from theſe, and a thouſand other inſtances that *Fame* and *Honour* are brittle like *Glaſs*, and inconſtant as the *Wind*, which whilſt it flatters, doth inſnare us, and when it ſhines ſtrongeſt, is neareſt its ſetting. Laſtly, why ſhould *Honour* be deſired, ſince it doth not depend on him who is praiſed, but is wholly in the *Power* of thoſe who give it? Neither are *Men Honour'd* becauſe they are *worthy*, but becauſe others think them ſo.

V. *Nobility being an external advantage only, cannot make Men happy.*

Others again cry up *Nobility*, and think it very much injur'd by thoſe who reckon it amongſt indifferent things, which do not concur either to *Happineſs* or *Miſery*. For they ſuppoſe it to be an innate *Worthineſs*, founded upon the *Vertue* and *Atchievments* of their *Forefathers*. But how can this make them better, ſince the *Nobility* they value ſo much is none of their own, but wholly derived and borrowed from others? Every one muſt have his own *Vertues*, ſince it is impoſſible for any *Man* to borrow them from another. What, am *I* to be accounted *Noble*, becauſe my *Parents* or *Anceſtors* were Famous and Renowned for their *Vertue*, and becauſe they deſerved well of their *Prince* and *Country*? We *Pride* our ſelves with that which is anothers, whilſt we boaſt of our *Pedigree*, and arrogate the *Praiſes* of our *Anceſtors*, as if due to us? For what elſe is this but to Rob the *Dead*, and to expect *Glory*, for what we never labour'd for? But beſides this, how often doth *Nobility* take its riſe from *Crimes* and *Wickedneſs*, and how frequently hath an honourable *Title* been the reward of *Murther* or *Treachery*? What more common than to purchaſe *Nobility* with *Mony* or *Pimping*, and for a man to become illuſtrious for his *Vices*? The Poſterity of ſuch as theſe cannot be ſaid to be *Noble* but *Notorious*, and the Riſe of the *Fathers Gentility*, becomes the reproach of his *Children*. But we'll ſuppoſe your *Anceſtors* to have been all of them great and Gallant

lant *Men*, and to have been beholden to their *Vertue* only, for their *Nobility*; yet can they not transmit this *worthiness* of theirs to you, nor indeed any thing besides their *Riches*, which without any regard to the Vertue of our *Forefathers*, we do often abuse to the Ruin both of *Soul* and *Body*. How often do we meet with *Gentlemen* by *name*, who, as to their *Manners* and *Accomplishments*, are very mean and inconsiderable? He is *Noble*, who hath a great *Soul*, disposed to *Vertue* and *Goodness*, who knows things that are *Right* and *Honest*, and doth heartily love and pursue them.

CHAP. VI.

What is the Highest Good of Man in this Life, and his Ultimate End.

I. *How the Highest Good, Happiness and Beatitude may be distinguisht.*

THO' from what hath been already said, it doth in great measure appear, what that is which we call the *Supream Good*, yet will it be of use in the beginning of this *Chapter*, to enquire what *Felicity*, and what *Bliss* is, and how they differ from the *Chiefest Good*. We commonly call them *happy*, who abound with the *Goods* of *Fortune*, and who without their own *Wit* and *Industry* jump into *Riches* and *Honours*. And therefore such are commonly said to be more *Fortunate* than *Wise*; forasmuch as the things they possess are only *external*, and do not properly belong to them. But *Beatitude* consists in that *Joy* of *Mind*, and *Tranquillity* of *Soul* which ariseth from the Possession of the *Chiefest Good*; and the *Highest Good* is that *Object*, the enjoyment whereof makes us *Blissful*, and than which nothing higher or better can be desired by us. So that the *Highest Good* of this *Life* is that *which makes a Man Blessed and Perfect here on Earth, according to the Possibility of this State.* And therefore all other things are only to be desired for the sake of it, and it only desirable for its own sake.

II. *The Chiefest Good of Man in General.*

It will be useful also for our better understanding of the *Nature* of the *Chiefest Good*, to consider *Man* in a double *state*, and that is either as a *Private Man*, and as he is a *person* that takes care of himself, and refers all things to his own *Good* and *Interest*: or as *Man-kind*, or the *Nature* of *Man* in general, which comprehends all *Men*, and does, as it were, constitute a *Body Politick*. The *Chiefest Good* of a *Man* considered in this latter sense, seems to be no other than a *Concurrence of all Perfections* whereof he is capable. For so *Man* cannot be lookt upon as most perfect, without he be furnisht, not only with the *Goods* of *Soul* and *Body*, but also with those of *Fortune*.

III. *The Chiefest Good of a Private Man.*

But forasmuch as we do not enquire here what it is that makes *Mankind*, or all *Men* collectively taken, *Happy*, but what makes every singular *Man* so; we say that the *Chiefest Good* of a *Private Man*, is *the right use of his Reason*, and which chiefly consists herein, that he have *a firm and constant purpose of always doing that, which he judgeth to be best.* And this is therefore the *Chiefest Good*, because no *Good* must be esteemed by us more than it, and all other things undervalued in comparison of it. And then because we enquire here after a Good which is in our *Power*, and can be obtained by us; and that the *Good things* of the *Body* and *Fortune* are without us, and come to us, and go from us without any contrivance or endeavour of ours; nor can we be said to possess those things which are only borrowed by us, and which we may lose the next moment; therefore it is of absolute necessity that we place our *highest Good* in our *Mind*, and that it depend on our Free *Will* only.

IV. *It consists in the due use of his two Chief Faculties.*

All that belongs to our *Soul* is compriz'd in 2 *Faculties*, *viz.* the *Power of Understanding*, that is, of knowing *Truth* and *Good*, and discerning them from *Evil* and *Falshood*: and *the Power of Willing*, or assenting to those things which we know to be *True* and *Good*. And in the right or *due use* of these 2 Chief *Faculties*, we say that the *Supream Good* of *Man* doth consist. Which is then chiefly done, when we diligently inspect whatsoever is propounded to us, and when we exert the utmost of the vigor of our *Mind* to the discerning of that which is best; which is the *first Function* or *Office* of our *Intellective Faculty*. And in the next place, that our *Choice* exactly follow our *Perception*, so as to undertake nothing which is not clear and manifest to us. For our *Knowledge* is the *Rule* of our *Actions*, and, as it were, the *Guide* of them, which we are to follow; and as long as we do so, we may be said to be out of the reach of *Error*: For tho' we may happen to be deceived, and tho' that which we have accounted *Good* may be only so in appearance, or may be indeed *Evil*, yet notwithstanding we are assured that we have performed what was our *Duty*, and have omitted nothing, whereby we might discover the true Nature of it.

V. *In order to the attaining of Beatitude, three things are to be done. The First.*

Which *satisfaction* of *Mind* we shall attain to, by giving heed to, and observing these 3 things which are the *Foundations* of all *Ethicks*, or *Moral Philosophy*. *First*, That we, according to our utmost endeavours, strive to attain the *Knowledge* of what we ought to embrace, and what to avoid in all the *Circumstances* and occurrences of our *Lives*. For seeing that many and various things happen to us, during the whole course of our *Life*, which according to the different *Circumstances* of *Time*, are called by different *names*, we are constantly to fix our *Eye* upon the *Dictate of Reason*, forasmuch as it often happens, that those things which were once *Good*, are accounted *Evil*; and that which was *Honourable*, is now lookt upon as *Ignominious* and *Despicable*. Above all, we must take heed of espousing the *opinions* of the *Vulgar*, not minding what *Men* commonly do, but what ought to be done.

VI. *The Second.*

The *Second thing* is, That we stand firm and constant to what we have once resolved upon and purposed; that is, that we retain an unmoveable *Mind* and *Will*, of doing those things which *Reason commands*, not suffering our *Passions* and corrupt *Inclinations* to lead us aside.

VII. *The Third.*

The *Third*, That we lay this down as an unmoveable *Ground* and *Principle*, that nothing besides our own *Thoughts*, is in our *Power*; and that therefore seeing the *Goods* we want, are without us, they are not to be wished for or desired by us.

VIII. *Whatsoever doth not proceed from our Free Will or Choice, deserves no Praise.*

The *Greatest Good* therefore that we can attain to in this *Life*, consists in the possession of all those *Perfections*, the obtaining whereof depends on our own Free *Will* or *Choice*; and seeing that

there is nothing, beſides the *Exerciſe of Vertue*, that is of this Nature, we are to conclude, that our proper *Good* and *Happineſs* doth therein alone conſiſt. For indeed, whatſoever doth not proceed from this *Principle*, neither merits *Praiſe* nor *Blame*; for *Praiſe* is the *Reward* of *Good Actions*, and can never be deſerved, if they be the effect of *Neceſſity*, and are not the Fruits of our *Free Choice*. 'Tis without *Reaſon* therefore that we delight our ſelves in *Riches*, *Honours* and ſuch like, ſeeing that they are things without us, and therefore do not belong to our *Happineſs*. We may be allow'd indeed to have ſome Value for them, but no *Praiſe* is due to us for them, any further than they have been acquir'd *juſtly* and *honeſtly*, that is, in the due uſe of our *Reaſon*.

IX. *Wherein the Bliſs or Beatitude of a Natural man doth conſiſt.*

Whence we may eaſily gather, That the *Natural Happineſs* of *Man*, is nothing elſe, but that *Tranquillity* or *Joy of Mind*, which ſprings from his Poſſeſſion or Enjoyment of the *Higheſt Good:* Which being nothing elſe but the *Right uſe of our Free-will*, we muſt conclude, that from the Poſſeſſion thereof our *Chiefeſt Pleaſure* muſt proceed. This will be evident as the *Sun* at *Noon-day*, if we conſider, that all *Pleaſure* and *Delight* is the Inmate of our *Soul*; and tho' there be ſome Delights which cannot be communicated to it, but by means of the *Body*, yet we may aſſert, that they are intimately preſent to the *Mind*: For it is the *Soul* which perceives all *Outward Objects*, tho' they be convey'd to her by the Miniſtry of the *Senſes*; and it is the *Soul* alone that is affected with, and capable of *Pleaſure*, whilſt ſhe perceives her ſelf poſſeſſed of the *Higheſt Good*, whereof ſhe is capable in this *Mortal Life*.

X. *It is impoſſible but he muſt be ſenſible of the Higheſt Joy, who lives in the due uſe of of his Free-will.*

Moreover, we are to take notice, that *Good things* are not ſo much to be rated by us, from the *Conveniences* or *Advantages* which accrue to us from them; as from the *Relation* and reſpect they have to us. Now ſeeing that *Free-Will* is properly and peculiarly ours, and that it is the Beſt thing we are Owners of, it follows, that nothing leſs than the *Higheſt Joy*, can be the reſult of the *Right uſe* thereof. For what can be more excellent in *Man*, than that whereby he is raiſed above all other *Animals*; than that whereby he reſembles the *Great* and *Glorious God*, ſeems to ſtand, as it were, on even ground with him, and to be exempt from his *Command*? Foraſmuch therefore as it is manifeſt that our *Free-will* is the greateſt of all *good things*, and that the poſſeſſion thereof is aſcertain'd to us, there can be no queſtion, but that the greateſt *Peace* of *Mind*, and the moſt ſolid of all *Pleaſures*, muſt naturally ſpring from the due uſe of it.

XI. *The Ancient Philophers were of the ſame Opinion.*

And by giving this Notion of the *Higheſt Good* of *Man*, we concur with the *Opinions* of the *Ancients*, and embrace the *Sentiments* of EPICURUS, as well as of ZENO, and the reſt of the *Stoicks*. For tho' EPICURUS placed the *Chiefeſt Good* in *Pleaſure*, and ZENO in *Vertue*; yet they may eaſily be reconciled by ſaying, that *Vertue* is to be accounted the one only *Good* of *Man*, foraſmuch as it alone depends on his *Free-will:* And ſeeing that full *Satisfaction* of *Mind* proceeds from the poſſeſſion of the greateſt *Good*, that therefore *Pleaſure* alſo muſt be a concurrent Means to make us *Happy*.

XII. *What that beſt thing is, we all aſpire after.*

The *Higheſt Good* of *Man* therefore conſiſts chiefly in 2 things, *viz.* in the *Knowledge of the Beſt Good*, and in the conſtant *proſecution of it*. If any one enquire what that *Beſt Good* is in the knowledge and purſuance whereof we muſt ſpend all our Endeavours. I Anſwer in a word, that the *Good of the Univerſe* is, that a Man in particular be happy, and all others with him. For ſeeing that the *Greateſt* of any *Good*, is to be meaſured by the Relation it hath to us, we are to take heed that whatſoever we undertake, may promote our *Happineſs*, and conduce to our chief and ultimate End.

XIII. *We muſt alſo do good to others.*

And foraſmuch as we are not born only for our Selves, but for our *Country*, and the *Society* and *Family* whereof we are *Members*, we are alſo to endeavour the well-being of others, and be no leſs ſolicitous for the *Good* of the *Publick*, than for our own. For *GOD* hath ſo order'd the *World*, and hath joyned *Men* in ſo cloſe and ſtrait a *Band* of *Society* and *Communion*, that tho' a *Man* ſhould be ſo Selfiſh, as only to mind himſelf; yet *Prudence* would move him to do *Good*, and be kind to others. Beſides, it is the Mark of a great and ſublime *Soul*, to do good to others; and the *Nobleſt Minds* are always found moſt carried out to *Beneficence*, and to have a low Eſteem of the *Goods* they poſſeſs: Whereas it is the *Character* of *Low* and *Little Souls*, to have a great Value for themſelves, and little or no Regard or Eſteem for others.

XIV. *The Intereſt and concerns of the Publick, are to be preferr'd before any Private Concerns whatſoever.*

Wherefore *Private men*, and ſuch as mind their own Intereſt, are oblig'd, as well as thoſe who are in a more *Publick Station*, to be helpful and aſſiſtant to others; and if they act prudently, will endeavour, to the utmoſt of their Abilities, to be beneficent to others, doing them all the *Good* they can. For this is the end and deſign of *Human Policy*, or *State Government*, to ſettle ſuch *Laws* whereby we may be helpful and uſeful to one another, or at leaſt, *not be hurtful* or prejudicial *to our Neighbours*. For whoſoever ſhall thus ſincerely and heartily obey the *Common Laws* of the *Society*, ſhall without doubt live more happily and ſafely, than thoſe who purſue their own profit, without any regard to the *Publick Good*; who tho' ſometimes they may ſeem to proſper, yet for the moſt part have an unhappy End, and frequently come to their Fall and Ruin, by thoſe ſelfiſh and unjuſt Means, whereby they deſign'd to raiſe themſelves.

CHAP. VII.

Of the Nature of Vertue in General.

I. *The Definition of Vertue in General.*

FOraſmuch as *Vertue* alone can make us happy, we can do no leſs than treat of it in particular, to the end we may be fully informed of the Nature of that thing, the poſſeſſion whereof procures our *Felicity*. For tho' all Men own *Vertue*, yet do they not agree in their Thoughts about the *Nature* of it. But not to trouble my ſelf about enumerating the Opinions of others, I ſay, that *Vertue* conſiſts in a *Steady Reſolution and Vigour of Mind, whereby we are carried to do things we believe to be Good*. For *Man* only is Praiſe-worthy for thoſe things that are in his *Power*, and which depend on his firm Reſolution of *Well-doing*.

doing. And it is of absolute necessity, that he who would Live well and happily, be constant and unmoveable in his *Resolutions*; for he that is wavering, and tost this way and that way by manifold *Passions* and *Inclinations*, doth not act, but is a Slave to his *Passions*; neither follows that which is *best*, but what is most pleasing to his *Lusts* and *Affections*.

II. *A firm Purpose is necessary to Vertue.*

The most necessary therefore of the Requisits to *Vertue*, is a *steady purpose and vigour of Mind*, by which we are readily and fully carried to the prosecution of that, which after due Examination, we find to be *Best*, without suffering our selves to be stopt or turn'd aside by any *Passions* or *Appetites* whatsoever. For as *Vice* proceeds from *Doubt* and *Wavering*, which are the Consequents of *Ignorance*; so on the contrary *Vertue* is founded upon a *firm* and steady *Purpose* of performing whatsoever *Right Reason* doth suggest. Which *Right Reason* is nothing else, but a *true Sense and Judgment concerning Human and Divine things, as far as they belong to, or concern us.* Wherefore also this is that which is the proper and peculiar *Good* of *Man, whereby*, to speak with the *Stoicks, he excels Beasts, and follows GOD.*

III. *The Laws of Vertue are truly Good, and unreproveable.*

Nor will this sound strange to us, seeing *Reason* is no other, but that *Power* of *Understanding* and Judging, derived from and communicated by *GOD*, the *Highest* and *First Reason*, which therefore we are to follow as a *Rule* in all our *Actions*, and to which we are to have a constant *Eye*, as to our *Sovereign Lady*, whose *Power* over us is most *Lawful* and Equitable, whose *Laws* are *Irreprehensible*, and all her *Statutes*, *Beneficial* and Perfective of our *Natures*. So that he that *Obeys* and follows her, cannot go astray, since by keeping her Dictates he obeys the *Divine Law*, written in his *Mind*, which is the Source and Rule of all *Equity*.

IV. *A firm Purpose of always doing what is Best, is a necessary Ingredient of Vtrtue.*

We have already said in the *Explication* of *Vertue*, that it *is a firm purpose of doing those things, which Reason tells us are Best*; because it is requisite that this *Will* be firm, and that the things we undertake, be throughly Examined by us. For those who perform the greatest *Actions*, do not merit any *Praise*, if they be not done after mature Deliberation, and with a steady Purpose. For *Vertue*, as SENECA tells us, *is not an Action, but the Exercise and Purpose of it.* For he who is prepar'd, dispos'd and resolved for the Patient enduring of the hardest *Trials*, and who is fully purpos'd to relieve and succour the *Miseries* of others, but is hindred of an Opportunity of exerting his *Vertuous Resolutions*, is without doubt possest of *Vertue*, tho' he hath not been able to exert or exercise it. So that seeing it is in our Power to *Judge* what we ought to do, and what to omit; yet can we not of right be said to be *Vertuous*, except we have a steady Purpose of doing whatsoever *Reason* shall propound to us to be Best.

V. Aristotle *makes Vertue to consist in the midst of Affections.*

ARISTOTLE, *Lib. 2. Ethic. cap. 8.* thus defines Vertue; *Vertue is an Elective Habit, consisting in Mediocrity with respect to us, determin'd by Reason, and agreeable to the Judgment of a Prudent man.* For according to him, *Vertue* consists in the midst of two *Affections*, and derives its Excellence from the Mediocrity it observes between them: For perceiving that *Liberality*, for Example, was attended by *Covetousness* and *Prodigality*; and that *Fortitude* was equally removed from *Cowardliness* and *Fool-hardiness*, he concluded *Mediocrity* to be the *Formal Cause* of *Vertue*, and to be conversant about the *Passions*, in which Excess and Defect is found. So that *Vertue*, according to him, is a kind of Mean betwixt 2 vicious Excesses.

VI. *This Definition doth not hold good, as to many Vertues.*

But tho' this may be allow'd, as to some *Vertues*, yet it cannot be asserted of all, forasmuch as many of them admit of no *Mean* at all. For what Extreams can we allot to the Affections of *Mercy* and *Benevolence*; seeing that they, in what state soever they be consider'd, are always *Good*, and always *Vertues*, whether they be in an *Intense* or *Remiss degree.* Again, what Mediocrity can there be conceiv'd in *Hatred, Envy, Pride*, when these *Affections*, how temperate soever they may be, are ever vicious, and therefore can never produce any *Vertue.* For this Mediocrity of *Vertue* is only to be met with in those *Affections* which we call *Indifferent*, which are neither *Good* nor *Evil* of themselves, as *Anger, Love, Desire, Fear*, and the like. For if *Anger* be moderate, it takes the Name of *Vertue*, but becomes a *Vice*, whenever it turns to *Rage* and *Fury*, which is the Excess of it; or sinks down into *Unconcernedness*, which is the defect thereof.

VII. *Charity, or Divine Love and Repentance, admit of no Excess.*

Moreover, the *Love* we bear to *GOD*, and the *Grief* we have for *Sin*, are both of them *Vertues*; and yet neither of them consist in a Mediocrity, since they have no bounds or limits, the one of them having *GOD* for its Object, who is *Infinite*; and the other respecting his opposite, *Nothing.* Now, who can *love GOD* to Excess? or be overmuch grieved for his *Sins*, or too much incensed against himself, for having offended his *Creatour*? No Body questions, but that *Adam*, in *Paradise*, was endued with many *Vertues*, as *Justice, Piety*, and the like: But what was the Form of these *Vertues?* It could not be *Mediocrity*, because he was not subject to any Excess of his *Passions.* And how could there be a Mean, without Extreams? Conclude we therefore, that the *Mediocrity* of *Affections*, is not the Form of *Vertue*; and that the same may be, tho' there were no vicious Excesses at all. Besides, all own, even those that are the Followers of ARISTOTLE, that *Justice* is not the Mean betwixt two Extremities, nothing being oppos'd to it, save *Injustice* only; and that, because it doth not give to every one his due.

VIII. *Mediocrity cannot be the Form of Vertue.*

But yet I do not deny, but that many *Vertues* are thus placed betwixt two *Vices*; for it is evident that *Magnificence* is a disposition of *Mind* between *Niggardliness* and *Sumptuousness*: *Modesty*, betwixt *Ambition* and *a stupid Carelessness*, and disregard of *Honour*: *Temperance*, between an *Insensibility* of all *Pleasure* and *Intemperance.* All that I contend for is, that this *Mediocrity* is not *Essential* to the Constitution of *Vertue*, and therefore cannot be said to be the *Form* of it: For so *Mediocrity*, for Example, in *Meat* or *Drink*, doth not deserve the Name of *Vertue*, as it is a Mean between the Excess and Defect of *Meat* and *Drink*; but for that it is according to *Reason*, and in compliance with the *Dictates* thereof. For the *Soul* that is under the *Governance* of *Reason*, chuseth the Mean between 2 *Extreams*, because it finds, that

that most suitable to it self. Neither need we to have recourse to this *Mediocrity*, since that which is must suitable and convenient for us, as we are *Rational Creatures*, must of necessity be a *Vertue*, tho' there be no Extreams between which it mediates. For he that exceeds all other *Mortals* in his *Love* to *GOD*, is so far from being blameworthy upon that account, that on the contrary he is highly therefore to be praised, because this excess is conformable to the *Precepts* of the *Natural Law* or *Reason*, which requires of *Man* the *Highest Piety*, and commands them to *Love* their *Maker*, with their whole *Mind*, and all their *Strength*.

IX. *All the Vertues are in conjunction.*

It is a common Saying in the *Schools*, That all the *Vertues* are undivided, and link'd together, so that he that hath one, hath all the rest also; which in some Sense may be admitted, that is, when we speak of *Heroical* or *perfect Vertue*; because such *Vertue* is supposed to have all the Excellence it is capable of. Sure it is, that all the *Vertues* are helpful and assistant one to another; for it is impossible for any one to be *Prudent*, without being partaker of *Fortitude*, *Temperancce* and *Justice*; neither can any *Man*, as *SENECA* saith, suffer bravely and boldly, without making use of all the *Vertues*, tho' *Patience* be the *Vertue*, that is most apparent in this case. For it is most certain, that *Fortitude* must be there also, *Patience* and *Endurance* being only *Branches* thereof: Neither is *Prudence* wanting, without which there can be no *Council* or *Advice*, who adviseth us to bear that courageously, which we cannot avoid. *Constancy* also makes one of this happy *Company*. And in a *word*, the whole *Chorus* of *Vertues* do meet in that one *Action* of suffering courageously; for indeed whatsoever is *Honestly* done, tho' it may be chiefly performed by one *Vertue*, yet is it not without the assistance of the rest.

X. *All the Vertues meet together in Prudence.*

And to evince this beyond Contradiction, let us consider, that there can be no *Vertue* without *Prudence*, and that all *Vertues* meet and are joyned in her. For every *Moral Vertue* only *executes* or performs what *Prudence prescribes*, and what agrees with the *Rule* and *Line* of *Right Reason*; and therefore it cannot be otherwise but that those *Vertues*, which partake of this *General Nature*, must be linked together, according to that *Axiom*, That those things which agree in a third, must needs agree with one another. Wherefore no *Vertue* can be without *Prudence*, neither can there be any constant or ready *Prudence*, without the Company of all the other *Vertues*. For as *ARISTOTLE* informs us, *Lib.* 6. *Ethic. cap.* 8. *The Judgment of our Reason about practical Principles, is subject to be perverted and deceived by the pravity of our Natures; so that it is evident that no Man can be Prudent, except he be a good Man also.* And consequently the *Vertues* that make Man good, cannot be separated from *Prudence*.

CHAP. VIII.

Of the Law of Nature and Right Reason, with the Practical Dictates thereof.

I. *Men tho' never so wicked, own the Law of Nature.*

Such a deep sense of the *Law* of *Nature* is impress upon the *Mind* of *Man*, that even the most *Wicked* and *Perverse* do profess to own and follow it: For *Men* in all their *Actions* appeal to the *Law* of *Nature*, and contend that they act according to it. A *Covetous Wretch* that with an insatiable desire scrapes and rakes together *Riches*, pretends that he acts herein according to the *impulse of Nature*, and follows her Teaching. An *Ambitious Person*, that by any means, tho' never so wicked and flagitious, makes his way to *Honour* and *Dignities*, meanly fawning upon some, that he may crush others, supposeth himself all this while acting conformable to *Nature*. He that is a *Slave to his Lust*, and abandons himself to *Luxury* and *Idleness*, brings in *Nature* to justifie his *Lewdness*, and contends that his *Debauchery* is consonant to her *Laws*: In a word, there is nothing so unworthy and contrary to *Reason* but hath its *Abetters*, that will prove it to be conformable to the *Light of Nature*.

II. *Every Nation hates Vice and Wickedness, and punisheth it.*

But these *Wretches* are much mistaken, who take their *Lusts* for the *Law* of *Nature*, and suppose the greatest violation of her, to comport with her own Dictates. For what *Nation* was ever so far corrupted, as not to condemn *Murthers*, *Incest*, *Theft*, *Rapin* and the like? For *Nature*, tho' it be greatly deprav'd and weakned in some *Countries*, yet for all that cannot patronize *Sin*; and as long as the least spark of *Reason* still glimmers in them, they condemn what other *Nations* forbid and punish. The *Laws of Nature* preserve and defend *Nature*, but are not destructive of it. Wherefore it will be worth our pains to enquire here, whether there be any certain and unalterable *Laws* of *well-living*, and doing, to which all *Men* are obliged, the violation whereof is accounted *criminal* amongst all *Men*: In order to the clearing whereof, we shall first consider what the *Laws* of *Nature* are, and how they may be defined.

III. *What the Laws of Nature are.*

The *Laws* of *Nature* are nothing else but a *certain Light or Notices which serve to guid and direct us in all particular occurrences, and which are derived from that general Reason, which* GOD *hath imprinted in the Souls of all men in their formation.* We say in the first place, that the *Laws of Nature are certain Notices which serve to guid us, &c.* to distinguish the *Laws* of *Nature*, from the *Rules* of *Motion*, which we sometimes also call *Laws* of *Nature*. We say in the second place, *that they are derived from that general Reason, &c.* to shew that the *Laws* of *Nature*, are nothing else but the consequences and effects of the *Light* of *Nature*; adding, *which* GOD *hath imprinted on the Souls of all men*; to signifie that the *Laws* of *Nature* are general and common, and that there is no *Man* in the World, how wicked and profligate soever he be, but hath some Sense and Knowledge of them, and that from *GOD* himself.

IV. *These Natural Laws have GOD for their Author.*

And therefore *ARISTOTLE Lib.* 3 *Politic.* saith, *he who will have the Law to bear sway, would have* GOD *to bear sway.* As if he would intimate

To the Worshipfull S.r Godfrey Kneller
of Lubeck in Saxony, and of S.t Pauls
Covint Garden in Middlesex Knight,
Principall Painter to their Majesties
King William and Queen Mary.

This Plate is humbly Dedicated by Richard Blome.

mate to us, that whatsoever *Reason* prescribes, ought not to be lookt upon, as the invention of *Mans Wit*, or the constitution of *Nations*; but as something *Divine* and *Eternal*, that governs the *World* by its *Commands* and *Prohibitions*. So that whatsoever deviates from this *Eternal Law*, is to be lookt upon as a *Monster*, and as a *Sacriledge*, against GOD, who is the *Author* of *Nature*, and of this *Knowledge* of *Good* and *Evil* in us. For *what else*, saith SENECA, *is Nature but* GOD *and the Divine Reason diffused through the Universe and all the parts of it; which meets thee whither soever thou turnst thy self: All the Reason that is in material things, is the Gift of* GOD *who ruleth all things.*

V. *That there are certain and unmoveable Laws of Nature, proved from the Nature of things in general.*

And that there are such *Eternals Laws* may be demonstrated from the *common Nature* of *things*. For the *World* which imitates the *Unity* of its *Author* and *principle*, is governed by one *Law* common to all *Creatures*, which as it provides for the good of the whole *Universe*, so of every particular *Being*. For whatsoever is contained in the *World*, is subject to the *Reason* of the *Divine Mind*, who is the *Regent* of the *Universe*. For the *Beings* that are *destitute of Reason* follow their natural instinct, and like *Arrrws shot* by an expert *Archer*, fly directly to the *Mark*; and the *Rational*, who are guided by the dictates of their *Judgment*, tend to their appointed *End*. So that the former are necessarily, and the latter freely and of choice, subject to this common *Law*. Hence it is that CICERO *L.* 10 *de legibus*, saith, *In the constituting of what is Right, we must take our Beginning from that supream Law, which took its rise before all Ages, when yet there was not any Written Law, or Civil society constituted.* And notwithstanding that almost in every different *Climate* we meet with different *Customs* and *Manners*; yet amongst them all, we shall find the Footsteps of this *Universal Law*, which binds not only the *Inhabitants* of one particular *Country*, but also those of the whole *World*.

VI. *From the Frame and constitution of Man.*

The same may be also made out from the end and *Constitution* of *Man*, whose peculiar privilege it is to have the use of *Reason*, and square his *Life* by it. For the *Dictates* of *Reason* are so evidently impresst upon his *Mind*, that he readily follows what is *Just* and *Right* without any *Matter*, without any *Written Law*, without any compulsion of the *Magistrate*, and discerns betwixt that which is equal and unequal, by the *Light* of his *Conscience* only. It is vain and useles to instruct *Men*, that *Murther* and *Adultery* are *Crimes*, and that *Theft* must be avoided, seeing that the *Light* of *Nature* anticipated this their information, and that all these *Laws* were long before *Written*, on the *Tables* of their *Hearts*. And therefore the *Sovereign Legislator* in delivering those *Laws* cuts them short, *Thou shall not kill. Thou shall not commit Adultery*, without adding any reason of them, as taking for granted that he addrest them to those who knew that already. For a *Ray* of the *Primordial Reason*, appears in *Man* by a twofold preeminence; for being *endued with Reason*, the light which illuminates other *Creatures* outwardly and superficially only, is his property and part of his *Essence*. And in the *second* place, the *Sense* of *Right* and *Truth* and *Affection* for it, is most intimately present in his *Heart*, whereby he is directed both in his *Speculation* and *Practice*. The *Minds* of *Men* are stored with the *Seeds* of *Vertue* and *Honesty*, which are excited by the least admonition, like a *spark* of *Fire*, which being only assisted with a small *Blast*, displays it self into a great *Flame*.

VII. *How GOD hath impresst these Laws on the Mind of Man.*

For GOD being concernd for the *Preservation* of *Man* whom he hath made, hath of his infinite *Goodness* and *Wisdom* engraven in their *Minds*, when he united it to the *Body*, a general *knowledge* of what is *Good*, that is, an *Idea* of whatsoever is conducive to the preservation of that Union. And it is this *Idea* or *Knowledge*, which we call *a Good understanding*, *Right Reason*, *the Light of Nature*; and the particular Notices derived from this general *Idea*, are those we call the *Laws* of *Nature*.

VIII. *Men that deviate from these Laws are to be herded amongst Beasts.*

And tho' some may think themselves very obsequious to the *Law* of *Nature* whilst they indulge their *Flesh*, and wholly abandon themselves to their *Lusts*, whilst they cram themselves like *Swine*, and are as *Luxurious* as *Goats*: Yet most certain it is that such *Men* as these do not follow their *Human*, but *Animal Inclinations*, and in a word, live like *Beasts*: For would they but attentively search into their own Bosoms, and consult the *Law* of *Universal Nature* written in their *Hearts*, it would appear a most monstrous and unjust thing to them, thus to disguise themselves with the *Manners* and *Passions* of *Brutes*, seeing that they are reasonable *Creatures*, and as such are obliged to direct their *Lives*, not by the compass of *Sense*, but *Reason*. They only *Live* according to *Nature*, who square their *Actions* by *Reason*, and who confine themseves to these three *Precepts*, *to Live Honestly*, *not to Hurt another*, *to give every one his due*. Which *Precepts* by the unanimous Suffrage, both of the *wise* and common *People*, are called the *Fountains* of all other, and a compendious, but *Essential Institution* of the *Law of Nature*.

IX. *The certainty of the Laws of Nature confirmed from the Relation Man hath to other Rational Agents.*

These unalterable *Laws* of a good *Life*, may be further demonstrated from the Relation *Man* hath to other *Rational Agents*; for seeing that *Man* is a *Sociable Creature*, and affects the company of such as are like him, it is necessary there should be some *Laws*, whereby they might be engaged to lend their mutual assistance one to another, and directed to *Love* their *Neighbours*. Accordingly *Men* following the impulse of *Nature*, and entring into *Civil Societies*, establisht this first Standard of *Justice*, *To live Honestly*, *to hurt no Body*, *and to give to every one his* Right. It is the *Right* of *Nature*, saith the *Law l.* 206. *F. de Reg. jur. that no Body enrich himself with the damage of another.* And therefore we find that there is no *Nation* so depraved in their *Manners*, which doth not abhor and abominate *ungrateful Persons*, *Mutherers of Parents*, *Breakers of Covenants*, *Deceivers*, *&c.* and think them worthy of the worst of *Punishments*, looking upon them as profest *Enemies* of *Society*, and violaters of the *Law* of *Nature*. How dismal would the condition of *Mankind* be, if it were lawful for every one to do what he listed, and to make his own *Lust* and *Humour* the *Rule* of *Good* and *Evil*? What *House*, what *Palace* would be secured from devouring *Flames*, if any one at pleasure might put Fire to them, and warm himself at the cost of another?

What *Wife* would be ſafe within her *Husbands Arms*, if there were no *Laws* to ſecure publick *Honeſty*, and to guard the Encloſure of the *Conjugal Bed*? *Nature* hath deeply engraven this precept in the *Hearts* of all, *Do not that to another, which thou would'ſt not have another do to thee*; this is that Dictate, which is preſent to all *Mens Minds*, and directs them, if ſo be they do not ſtop their *Ears* to its *Voice*, and liſten to their *Paſſions* rather than their *Reaſon*.

X. *Man is furniſht with the Idea's of Good and Evil, which are ſuch of their own Nature.*

From what hath been ſaid, may be gathered, that there are ſome certain and immutable *Idea's of Good and Evil*, whereby, under the ſole guidance of *Nature*, we diſtinguiſh things that are *juſt*, from thoſe that are *unjuſt*, and things *honeſt*, from *filthy* and *unbecoming*: Like as by the different notations of *Figures*, we diſtinguiſh *Mathematical Schemes*, and ſeparate them from one another. For as we define *Figures*, not by *Senſe*, but by *Reaſon*; ſo we perceive what is *right* or *unjuſt* by *Reaſon*; which teacheth us that *Good* is to be deſired, and *Evil* to be avoided. The ground whereof is this, becauſe *Good* and *Evil* from whence our *Idea's* are taken, do not depend on the *Judgment* of any *private perſon*, or of any multitude of *Men* how great ſoever, but are ſuch of their own *Nature*, and therefore neceſſarily to be embraced, or avoided by *Intellectual Creatures*. For as the *Underſtanding* of *Man* doth not enquire what appears to ſome to be *Truth*, but what is *Truth* ſimply and in it ſelf: So likewiſe the *Will* of *Man*, doth not embrace that for *Good*, which ſeems to be ſo to ſome private perſons, or to moſt *Men*, but what is really and immutably ſo, and which is to be choſen and embraced in ſpite of, and notwithſtanding all the Reluctance of our *Animal propenſion*. And therefore as there is ſomething in *Nature* which is abſolutly and ſimply *True*; ſo likewiſe muſt there be ſomething that is good in its own *Nature*, and for its own worth and lovelineſs to be deſired by the *Will* of *Man*. And therefore as he abuſeth his faculty of *Underſtanding*, who being impoſed upon by the deceptions of *Senſe* or *Imagination*, doth not perceive what is naturally *True*; ſo in like manner he alſo abuſeth his faculty of *Willing*, who ſuffers himſelf to be ſo blinded by his *Animal Appetite*, as not to chuſe that which is good of its own *Nature*, and for want of due attention fails of his end and aim.

XI. *Some Sentences into which Moral Reaſon may be reſolved.*

Now what *Method* or *Order* a *Man* is to follow in his choice, and what *Good* he is to embrace in ſuch *Circumſtances*, will appear from the ſubjoyned *Axioms*, into which the whole *Nature* of *Vertue* may be reſolved.

1. *That is accounted Good, which is agreeable to Intellectual nature, and is commenſurate to its State and Condition, and is ſome way or other conducive to the Conſervation of the perceiver.*

2. *On the contrary, that is accounted Evil, which is inimicitious or oppoſit to an Intellectual Nature with reſpect to its Condition, and cauſeth grief and averſion to it; and if it threaten its deſtruction, then is it eſteemed to be the worſt of Evils.*

For one *Evil* ſupervening to another, is thereby made the more *Heavy*. For it is ſeldom ſeen ſaith *ALEXANDER ab ALEXANDRO*, that a Commonwealth ſhaken at once with inteſtine and forein War, can hold out long; for the ſuperadded danger by dividing their Councils and Subſidies, which otherwiſe were ſcarce ſufficient to ſtem its double Tide, makes them ſtill weaker, and ſo at laſt over-throw the tottering Commonwealth.

3. *All Good is not equal, as the Stoicks held, but ſome preferable to other, ſince it is certain that that Good is more excellent, which exceeds another in Nature, Duration, or both.*

For it cannot be queſtiond but that *GOD*, who is *Eternal*, and who by his *Nature* includes all other *perfections*, muſt needs be a more excellent *Good* than the *Creature*, how perfect ſoever. And that an *Angel* in Goodneſs excells *Man* and *Beaſts*. So that the value of *Good* may be conſidered after a twofold manner; either *Intenſively*, as it affords the greateſt ſatisfaction to the *Mind*; or *Extenſively*, according to its more ample diffuſion of the ſame, and its greater tendency to the *Good* of the *Univerſe*. From whence afterwards follows its *Duration*; for the more durable any *Good* is, the more excellent it muſt be alſo, and is ſo to be eſteemed.

4. *It is the peculiar property of Good to move the Will to the choice and embracing of it; whereas Evil produces the contray effect; and even as a greater Good kindles a greater Love of it ſelf; ſo a leſs Evil is to be born, to avoid a greater.*

Becauſe a leſs *Evil*, with regard to a greater has the appearance of *Good*. Whence came that common *Axiom* amongſt *Moraliſts*, that *of 2 Evils the leaſt is to be choſen*. For ſeeing that *Nature* doth always what is beſt, therefore it alſo avoids the greater *Evil*; for a leſs *Evil* comes nearer to *Good*, and is accounted comparatively *Good*. Hence it is that *Men* to avoid being *burnt*, caſt themſelves from a Precipice, or leap into a *River* to avoid the Jaws of a *Wild Beaſt*, or the *Sword* of a *Robber*, and to keep themſelves from periſhing there, lay hold of *Thorns* or *Briars* or any thing how painful ſoever, to ſave their *Lives*.

5. *If any thing happen to us, whoſe nature we are ignorant of, we may ſafely truſt thoſe, who profeſs themſelves skilful in that matter; in caſe we are fully perſuaded of their skill and faithfulneſs, and that it be evident to us, that there is no deceit in the matter, or deſire of particular gain or advantage.*

6. *Tho' the event of things be doubtful, yet when ever we apprehend that any Good thing will happen, we ought to take as much pains to obtain it, as if it were preſent; ſince if we do ſo, it ſhall certainly come to be our lot at laſt.*

7. *In the judging and diſcerning of things, we are to take care that the Mind may be free from all the Prejudices of Infancy, and Enticements of our Paſſions; for the Underſtanding being clouded with the dark ſmoak of the Paſſions, cannot diſcern the Good, and the Will following its guidance, miſtakes in her choice.*

These few *Sentences* or *Axioms*, are ſufficient for the forming of *Ethical Demonſtrations*, and for the begetting in us the 4 *Vertues* hereafter to be explained. And as to the *Duty* we owe to others, the ſame is comprehended in this general *Axiom*, *Whatſoever thou wouldſt not have another do to thee, neither do thou to him.* Which is of as great extent and force in *Morals*, as *Charity* or *Divine Love*, (which comprehends all *Vertues* and *Graces*)

XII. *Our Duty to others.*

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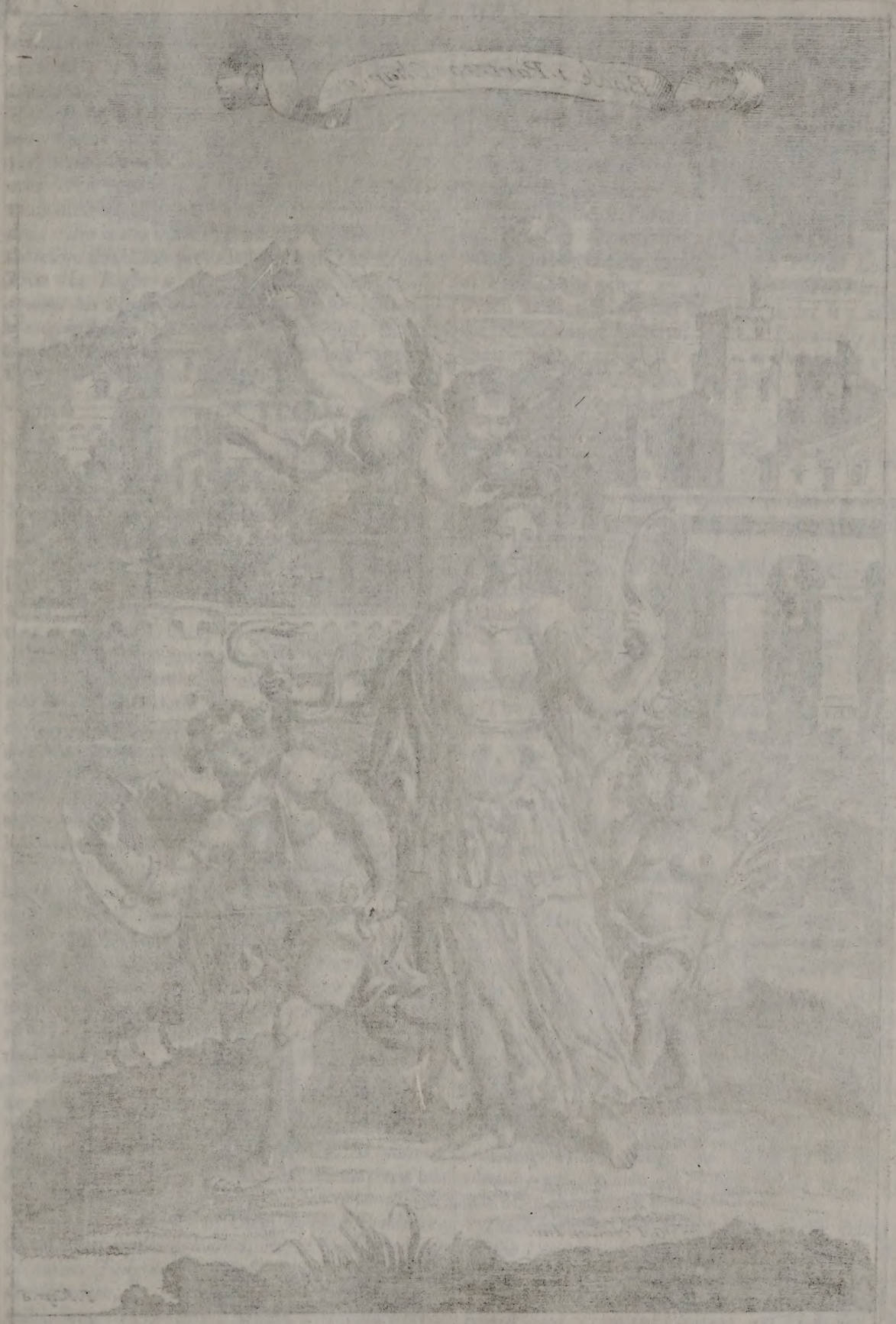

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is in *Divinity*. Thus a *Man*, from the *Command* of *GOD*, conſiders his *Neighbour*, and learns to *love* him as himſelf: For in a like caſe, and in a like reſpect to *GOD* and his *Law*, a like *Judgment* muſt be made. If you think it unjuſt, that you ſhould be *robb'd* or *oppreſt* by one more powerful than your ſelf, by parity of *Reaſon* neither muſt thou thy ſelf poſſeſs thy ſelf of the *Goods* of one, who is too weak to reſiſt thy Violence. And therefore this *Law* prevailed amongſt the *Romans*, *That the Right a man vindicates to himſelf againſt his Neighbour, the ſame may his Neighbour uſe againſt him.* Becauſe it is but juſt, that the ſame Meaſure a *man* meaſures out to another, ſhould be meaſur'd to him again.

CHAP. IX.

Of Prudence; and the Parts of it.

I. *The Diviſion of Vertue.*

VERTUE is commonly divided into 4 Species, *Prudence*, *Temperance*, *Fortitude* and *Juſtice*, which *Ethical Writers* call *Cardinal*, becauſe they conſider them as the Hinges upon which all other *Vertues* turn, and from whence they proceed as ſo many *Branches*.

II. *The Nature of Prudence, and what it is converſant about.*

The firſt Rank amongſt theſe is given to *Prudence*, which makes uſe of all the reſt, and as the *Eye* of the *Soul* doth point out to them their Order and Manner; and accordingly may be defined *a firm and conſtant Will, heedfully to look out, and diligently to examine what is beſt.* For it is the *Office* of a *Prudent man*, not to undertake any thing, which he hath not firſt weighed in the Balance of *Reaſon*, and found, that according to the preſent Circumſtances of *Place* and *Time*, wherein he undertakes a thing, there is no truer, or at leaſt more probable *Reaſon*, than that which he is reſolved to follow. For *Prudence* is not a certain *Science*, which contemplates things neceſſary, and which can be no otherwiſe than they are; but a kind of knowledge that is converſant about *Contingent matters*, which are not only mutable, as to their Manner, but as to their *Exiſtence*. For tho' the *Object* of *Prudence* generally conſider'd be ſomething common, *viz.* whatſoever ought to be done according to *Right Reaſon*; yet *Prudence*, as conſider'd in every particular *Man*, is converſant about *Singulars*, which may, or may not be; or may be thus, or otherwiſe.

III. *The Three Duties or Offices of Prudence.*

There be 3 *Offices* or Chief Acts of *Prudence*; *Good* and *wary Conſultation*, *Right Underſtanding* or rather *Judgment*, and *Sentence* or *Command*. *Conſultation*, or *Deliberation*, doth above all the reſt belong to *Prudence*, whilſt it conſiders what Means are moſt proper and beſt to obtain her End; to which is oppos'd *Precipitancy*, when we do things raſhly and inconſiderately. And to the end this *Conſultation* be ſuch as it ought, it muſt be done with due Conſideration, and aim at a *good End*; for otherwiſe it will be only Cunning and Craftineſs. *Right Underſtanding*, or *Judgment*, is that whereby we paſs a dextrous *Judgment* of the Means, by a reflex Act, approving of them. And is therefore called by ARISTOTLE, a *quick* and *ready Underſtanding*; to which is oppos'd *dulneſs* of *Mind*, or *Folly*: So that a *Prudent man* ſeems in ſome ſort to keep the middle Station, betwixt a *Block-head* or *Dull-fellow*, and a *Crafty Knave*. The *Sentence*, or the *Habit* of paſſing a Decretory Sentence, concerning the Goodneſs of the *Means*, follows next after *Judgment*, and is that whereby a *Prudent man* rightly determines, how to make uſe of the Means which he hath judged to be beſt, and with Conſtancy puts the ſame in practice.

IV. *Of the Parts of Vertue in General.*

Three kinds of *Parts* are aſſigned to every *Vertue*, the firſt whereof are *Helps* or Advantages, which are neceſſarily required to the *Perfect Law* of *Vertue*; the other are called *Subjective Parts*, which as ſo many *Species* do reſort under it; and the laſt are called *Potential*, which *Potentially* are contained in the chiefeſt *Vertues*, and which do not comprehend their whole Natures, but belong to ſome *ſecondary Laws*.

V. *Of the Conſtituting Parts of Prudence.*

The *Conſtituting parts* of *Prudence* are,

1. To know the *Laws* of *Nature*, according to which we ought to live.

2. To compare them together, that we may know what place they muſt take, or which of them hath the Precedency.

3. To conſider, and have regard to the Circumſtances of *place*, *time* and *perſons*, in all our Actions.

4. To have an Eye to our *Chief End*, and to purſue the ſame by all honeſt and lawful Means.

VI. *The Integral Parts of Prudence*

The *Helps* required to *Prudence* are reckoned 8 in number, *viz. Memory*, *Underſtanding*, *Forecaſt*, *Teachableneſs*, *Quickneſs of Wit*, *Reaſon*, *Circumſpection*, and *Cautelouſneſs*. Of which ſome are helpful to *Conſultation*, others to *Judgment* or Diſcerning, and laſtly, others to *Sentencing* or *Determining*.

VII. *Sharpneſs of Wit.*

Sharpneſs or Quickneſs *of Wit* belongs to *Conſultation*, or *Deliberation*; by means whereof a *Prudent Man* finds out the Means, which conduce to the obtaining of his propoſed *End*. This Help is of kin to *Sagacity*, which ſpeaks a diſpoſition in the *Soul*, whereby it readily and dexterouſly diſcovers what lies hid, and finds out the Ways which are the ſhorteſt and ſureſt to the deſired *End*.

VIII. *Intelligence or Underſtanding.*

Underſtanding, or *Intelligence*, is a Help to our *Judgment* or Diſcerning; and it is not here taken for a Habit of the *firſt Principles*; but for a *knowledge* of the things that ought to be done, whereby we perceive and judge rightly of things that offer themſelves.

IX. *Teachableneſs.*

Teachableneſs is a *Promptitude* of the *Mind*, for the *Learning* of the *things* we are ignorant of: For ſeeing it is the part of a *Prudent man* to know many things, and to be able to diſtinguiſh the *Honeſt Good*, from the *Pleaſant* and *Profitable*, it is neceſſary that he be *Teachable*, ſo as to improve himſelf by the *Diſcourſes* of others, or in the *Reading* of *Books*.

X. *Memory.*

Memory is that, whereby a *Prudent man* calls to Mind things that are paſt, and repreſents to himſelf ſeveral *Actions* and *Events*, from whence, as from the *Premiſſes*, he concludes what *Judgment* he ought to paſs of the future.

XI. *Reaſon.*

Reaſon is the right uſe of the Knowing Faculty, whereby a *Prudent man*, from fore-known and pre-conſider'd things, argues aright, gathering and judging what he ought to do in preſent Circumſtances.

In

XII. *Forecaſt, Circumſpection and Cauteloufneſs.*

In order to *Command*, or the paſſing of a *Decretory Sentence*, a *Prudent man* is aſſiſted by Forecaſt, Circumſpection, and Cauteloufneſs: *Forecaſt* is that Habit whereby he diligently conſiders Future things, and from things that are paſt, gathers what will be, and accordingly reſolves what to do. *Circumſpection* is that Habit, whereby the Circumſtances of Affairs are heedfully and diligently minded. And laſtly, *Caution*, or *Heedfulneſs*, is that whereby *Obſtacles* that might happen are removed, and all Impediments that might hinder the obtaining of our intended End.

XIII. *The Subjective Parts of Prudence*

The *Subjective parts* of *Prudence*, according to the *School-men* are 4, *viz. Private* or Solitary Prudence, *Oeconomical*, *Political*, and *Military*.

XIV. *Wherein Private Prudence doth conſiſt.*

Private Prudence, tho' it be frequently confounded with the *Monaſtick*, yet is it not peculiarly to be reſtain'd to thoſe that lead a *Monaſtick Life*; and ſeparating themſelves from the *Multitude*, betake themſelves wholly to *Contemplation* and *Devotion*; but is that which belongs to every Singular *Man*, who, whether he hath none to take care of but himſelf, or whether he takes care alſo for others, ſtands in need of *Prudence*, to direct and aſſiſt him in his ſeveral Actions.

XV. *The Firſt Office of Private Prudence.*

The Office of *Private Prudence* is twofold; the Firſt, That every one do chuſe ſome kind of Profeſſion or Way of *Living*, wherein he may ſpend the reſt of his *days*: For no *Man* can be happy that keeps no certain Courſe of *Life*, but being unreſolved and wavering, is ever deliberating what Condition of *Life* he had beſt embrace, and to what Order of *Men* he had beſt joyn himſelf. *Prudence* therefore adviſeth every *man* to conſult his own *Genius* and *Ability*, and to chuſe for himſelf ſuch a State of *Life* as comports with his *Natural Gifts*, and the Temper of his *Mind*, and wherein he may with Pleaſure and Satisfaction, continue throughout the Courſe of his whole *Life*.

XVI. *The other Duty of Private Prudence.*

The other Duty of *Private Prudence* is, that having once pitch'd upon a ſet State or Condition of *Life*, he uſe all poſſible Induſtry that he ſquare all his *Actions* by the Rules of *Vertue*, according to the Dictates of *Reaſon*; and take heed to commit nothing that may neceſſitate him to *Repentance*. All which he may, without any great difficulty obtain, in caſe he undertake nothing without mature Deliberation, and be conſtant and firm in his Purpoſe, when once he is aſſur'd of the *Goodneſs* and Honeſty of them. For the chiefeſt part of *Human Beatitude* conſiſts in *Acting conſtantly*, and never turning aſide from the Right path of *Vertue*.

XVII. *What Oeconomical Prudence is*

Oeconomical Prudence is, that whereby a *man* orders the Concerns of his *Family*. Its Dictates are, that no *man* raſhly or inconſiderately caſt himſelf into the indiſſoluble Band of *Matrimony*; but that he conſider well of it before he enters a State, which he cannot quit again at his pleaſure. That the *Woman* he takes to be his Wife, be adorned rather with the Embeliſhments of *Mind*, than of *Body*; and that ſhe be more recommendable by her *Chaſtity* and good *Manners*, than by her *Riches* or *Portion*. Alſo, that there be an *Equality* between him and her, ſince it is a common thing for a *Wife*, who is above her *Husband* in *Nobility* or *Riches*, to deſpiſe him, and look upon him rather as her *Servant*, than her *Husband*. *Prudence* alſo adviſeth, that he ſeriouſly weigh and conſider the *Temper* of *Women*, the *defects* and *weakneſſes* they are ſubject to, and that their *Will* is commonly much ſtronger than their *Reaſon*, and their *Phanſy* and *Humour* the Law of their *Actions*: That many *Husbands* have only 2 good and pleaſant Days, as HIPPONACTES ſaith by STOBÆUS, the one, that of their *Marriage*, and the other, that of their Wives *Burial*: That being once *married*, he muſt treat her as his *Wife*, by communicating his *Secrets* unto her; eſpecially if he knows ſhe can hold her *Tongue*, and conceal what ought not to be divulged; leſt ſhe ſhould conceive her ſelf to be ſlighted or neglected, and by this means becomes careleſs of her *Duty*.

XVIII. *How Children and Servants are to be ordered and Governed.*

Prudence alſo preſcribes Rules, how *Children* ought to be *Educated*, and *Servants* kept to their *Duty*; which it would be too prolix to inſert here, and may be ſeen ſet down at large in a Treatiſe which I have written in *French*, concerning *Vertue*, conformable to the Sentiments of *Epicurus*, entituled *L'Epicure Spiritual*.

XIX. *The Precepts of Political or State Prudence.*

Political, or *State Prudence*, imitates the *Oeconomical*, and differs from it only in this, that its Subjects are more numerous: For as the former is concern'd with governing ones *Wife*, *Children* and *Servants*; ſo *Political Prudence* conſiſts in *Ruling* a *City*, *Province*, or *Nation*. In order to the diſcharging of which *Function* aright, it is firſt neceſſary that he who bears *Rule* over others, does himſelf excel in *Vertue*, that his *Actions* may ſerve for *Examples* to his *Subjects*. For *Subjects* think it their Glory to imitate the *Manners* of their *Prince*, and to expreſs him in all their *Actions*, *Words* and *Geſtures*. Hence it is, that the *Crimes* and *Vices* of *Princes* ſpread like a Contagion, and infect the whole *Body* of their *Subjects*: For they think, that what their *Princes* do, is not only lawful for them, but even *Praiſe-worthy* alſo; ſo dangerous are great *Examples*, and ſo effectual for the promoting of *Vice* and *Wickedneſs*. He therefore that Governs others, muſt carry a *Majeſty*, and command Reſpect, not by his Big and Severe *Looks*; but by the Rectitude of his *Manners* and Heroical *Vertue*.

XX. *Princes muſt be Religious, and true to their words.*

As it is highly commendable for *Princes* to be *Religious*, and Eminent in their *Piety* towards *GOD*; ſo muſt they alſo excel in punctual *Faithfulneſs* and *Truth* towards their Equals. For a *Prince* that doth not keep his *Word* and *Promiſe*, makes himſelf Vile and Deſpicable, becauſe it is a mark of *Fearfulneſs* and *Impotence* to break his *Word*, and to elude the Execution of his *Treaties*. *Prudence* therefore adviſeth, that a *Prince* be exact in performing of his *Word*, and juſt and equal in his *Actions*. For *Rulers* are not exempt from, or above all *Laws*, for *Juſtice* is above them; and if it be in their power to do what they pleaſe, yet are they not to will any thing, but what they ought. It muſt be alſo a great part of their Care, to have an Eye to the *Great Officers* and *Magiſtrates* under them, to ſee that they perform their *Duties*, to the end that the *Judges* may be Honoured, the *Laws* Reverenced, and they themſelves Loved and Dreaded.

Military

XVIII. How Children and Servants are to be ordered and Governed.

XIX. The Precepts of Politicall or State Prudence.

XX. Princes must be Religious, and true to their words.

To the Right Worshipfull S.r
Edmund Turnor of Stoke-Rochford
in the County of Lincolne Knight.

This Plate is humbly Dedicated by Richard Blome.

XXI. *What Military Prudence is.* *Military* Prudence, which chiefly belongs, and is neceſſary to the *Commanders* in Chief of *Armies*; teacheth how to undertake a *War*, carry it on, or bring it to an happy Iſſue: Firſt, by inſtructing them not to enter upon it raſhly, and without good Advice; having firſt well weighed their own *ſtrength*, and being moved to it by a juſt Cauſe. For if they find, that the *Power* they intend to oppoſe will prove an over-balance for them, *Prudence* will adviſe them to deſiſt from the Thoughts of attacking a too Potent *Enemy*, and to conclude a *Peace* with them, rather than hazard the Loſs or Ruin of their *Kingdom*. But if *Peace* cannot be had but upon unreaſonable Conditions, then a *War* is to be hazarded; and after having implor'd the Divine Favour by Prayers, and encouraged the *Souldiers*, they are to give Battle, and to dye rather, than to loſe their *Right* and *Liberty*.

XXII. *What things are neceſſary for the waging of War.* In the waging of *War*, great care is to be taken, *firſt*, to Liſt ſtrong and couragious *Souldiers*, Exercis'd in *Arms*, and hardned to Labour and *Service*. *Secondly*, That they be well *Arm'd*, not only with *Defenſive*, but alſo *Offenſive Arms*. *Thirdly*, That a ſufficient Quantity of *Proviſions* be provided, and ready at hand, for the ſupply of the *Army*, ſeeing that for want thereof, not only *Caſtles* and *Towns* are often loſt, but whole *Armies* ſometimes miſcarry. *Fourthly*, That there be ſtore of *Mony*, which is the *Sinews* of a *War*, and without which the *Souldiers* cannot be kept to their *Duty*, nor reſtrain'd from *Robberies*. Theſe 4 things being well fore-caſt and provided, *Princes* or *Generals* may ſafely undertake a *War*, and Invade their *Enemies*, ſince this is all that *Military Prudence* requires, in order to the Succeſsful carrying on of a *War*.

XXIII. *Prudence is acquired two ſeveral ways.* From what hath been now ſaid, it is eaſie to conclude, that the ways of acquiring this *Vertue* of *Prudence*, are reducible to 2 only, *viz.* to *Precepts* and *Experience*. The latter of which is two-fold, *viz.* ones own *Experience*, and that of another. Proper *Experience* is the *knowledge* of *things*, that we our ſelves have ſeen or done; and the other is the *knowledge* of *things*, that have been ſeen or done by others, and which we have only by Relation. The *Prudence* we get by *Experience* and Uſe, is much more ſure and certain, than that which is attain'd by *Precepts*, or by the *knowledge* of *Hiſtory*; but as it is more excellent, ſo likewiſe it is more difficult to be obtained.

CHAP. X.

Of Temperance.

I. *About what things Temperance is converſant.* TEMPERANCE is ſo nearly ally'd to *Prudence*, that it always accompanies it, and ſeconds it in all its *Laws*; and was therefore called by the *Ancients*, the *Conſervatrix* of *Prudence*, becauſe it preſerves the Soundneſs of the *Mind*, and is very conducive to Conſultation and *Judgment*. For an *Intemperate perſon* ſeems to have ſuffer'd *Shipwrack* of his *Reaſon*, and therefore ought to be ſerv'd as *Mad-men* are, in order to the Recovery of it. For *Temperance* imports nothing elſe, but the *Moderation of Reaſon*, and the abſolute Command of the *Soul* over all its *Paſſions*: For it ſuppreſſeth *Concupiſcence*, ſtifles vain *Hopes*, moderates *Love*, and keeps the *Mind* from being ruffled by any other Perturbations whatſoever. But being taken in a ſtricter Senſe, it ſignifies the reſtraint only of thoſe Pleaſures which belong to the *Taſte* and *Feeling*, which are common to us with the *Beaſts*; and to which, according as *Men* either addict themſelves, or bid defiance, ſo they are termed *Temperate* or *Intemperate*.

II. *The Definition of Temperance* We may therefore define *Temperance*, *A firm and conſtant Will or Reſolution, to reſiſt and reſtrain Bodily Luſts and Pleaſures, eſpecially thoſe that belong to the Taſte and Touch.* By which words it appears, that thoſe *Pleaſures* are excluded which belong to the *Senſes* of *Seeing*, *Hearing*, and *Smelling*; and that *Temperance* in this Senſe, is only converſant about the pleaſures of the groſſer *Senſes* of *Taſting* and *Touching*.

III. *Decency and Baſhfulneſs do conſtitute Temperance* The Parts which in ſome ſort may be ſaid to conſtitute *Temperance*, are *Honeſty* or *Decency*, and *Baſhfulneſs*. For there is a kind of Comlineſs beaming forth from *Temperance*, which allures *men* by its *Lovelineſs*, and makes them to reſtrain and repreſs flattering *Pleaſure*, and to deny whatſoever is moſt pleaſing to the *Body*. For it is a commendable thing to avoid all *Immoderateneſs*, and to follow *Temperance* only for the Comlineſs and Lovelineſs of it. *Baſhfulneſs* alſo is a great help towards the exerciſe of this *Vertue*; whereby we fear *Infamy*, leſt by indulging our *Luſts*, we ſhould expoſe our ſelves to ſhame, and loſe our Fame and good Repute by our *Intemperance*: for *Shamefac'dneſs* or *Baſhfulneſs*, is not here taken for a *Paſſion*, but for a kind of Fearfulneſs of incurring Reproach and Diſgrace, by committing any ſhameful Action; which *Fear* of *Shame* may well be called the *Guardian* of *Vertue*, as being always accompanied with a laudable Moderation.

IV. *Sobriety and Chaſtity are the two Species of Temperance.* There be 2 *Species* of *Temperance*, viz. *Sobriety* and *Chaſtity*, the former whereof moderates our *Eating* and *Drinking*; the latter ſets Bounds to the Enjoyment of a *Conjugal Bed*.

V. *The Precepts of Sobriety.* *Sobriety* teacheth us, that our *Bodies* are contented with a little, and cannot without Pain and Prejudice bear what is ſuperfluous. And accordingly hath given us a Meaſure, by which every one may be informed what quantity of *Meat* and *Drink* he ought to uſe. For *Nature* being a Careful *Mother* of her *Children*, condemns all thoſe things that ſerve to tempt and provoke an *Appetite*, and which are taken rather for Pleaſure, than for Neceſſity; and teacheth us by daily Experience, that *Diſeaſes* and *Infirmities* of the *Body*, are the Fruits of *Intemperance*, and that Pains and Dulneſs of the *Head*, Crudity of the *Stomach*, Griping of the *Guts*, would be in a great meaſure unknown to Men, if they did not by *Drunkenneſs* and *Gluttony* pull them down upon themſelves. Whereas on the contrary, *Sobriety* ſecures the *Body*, reſtores decayed *Strength*, and by reducing the *Humours* to a due *Temperament*, eaſily ſubjects the *Paſſions* to *Reaſon*. Do we think that he is wholly depriv'd of *Pleaſures*, whoſe Diet are the *Fruits* of the *Earth*, and contents himſelf with *Viands* that are prepared without the need of a *Cook*? Such an one as he enjoys a vigorous and healthful Conſtitution of *Body*, in which his *Soul* exerciſeth her Functions freely and expeditely:

So *Abſtinence* to him is inſtead of the moſt delicious *Liquor*, as preſerving his *Health*, and fortifying it againſt all *Infirmities*. Wherefore we muſt accuſtom our ſelves to a Moderation in *Diet*, if ſo be we would enjoy a ſound *Mind*, in a Healthful and ſound *Body*. And this will be our portion, if contenting our ſelves with Common *Food*, we ſhall deſpiſe *Dainties*, except only ſo far as may be neceſſary for the Recovering of our *Health*, and to comply with the Advice of our *Phyſician:* Since nothing is more ſure than, that *Meats* are ſpoiled and adulterated by too much care and exquiſitneſs in Dreſſing; and that the Art of *Cookery*, for the moſt part, leaves them more unwholſom than it found them.

VI. *By what means Chaſtity may be procured. Firſt by a Spare and Abſtemious Diet.*

And as for *Chaſtity*, which permits no *Pleaſures*, beſides thoſe that are enjoyed in Lawful *Wedlock*, it will be of uſe to ſet down ſome Preſervatives, whereby a *Man* may ſecure himſelf againſt the violent Attacks of *Carnal Luſt*, and render *Chaſtity* eaſie and familiar to himſelf. The Firſt and Chiefeſt of theſe Preſervatives is, that he uſe a *ſlender Diet*, and carefully avoid all *Meats* and *Drinks* that are enflaming. For it is very hard, or rather impoſſible, for a *man* to indulge himſelf in *Gluttony*, and not to be tormented with *Luſtful motions*. For *Gluttony* and *Carnal Luſt* are ſo cloſely ally'd, that, as TERTULLIAN hath it, *Luſt* without *Gluttony*, may well paſs for a *Prodigy* or *Monſter*. Let the *Body* therefore be fed with that Caution, that the *ſtrength* of it only may be preſerved, without furniſhing Copious Matter to increaſe a *Paſſion*. *Food* is afforded us for the maintenance and ſupport of our *Bodily Lives*; and tho' it be neceſſary to our *Nature*, yet is it to be taken with care and anxiety, leſt it ſhould ſupplant our *Chaſtity*, and excite us to *Uncleanneſs*.

VII. *Secondly by Buſineſs and Employment.*

The *Second* Preſervative is, that he be always buſied and employ'd in ſome honeſt *Calling*, without indulging *Sloth* or *Idleneſs:* For continual Buſineſs or Study waſts the *Animal Spirits*, which invigorate us; or at leaſt by taking up the *Mind*, divert it from *Luſtful Thoughts* and *Imaginations*. *Idle perſons* are moſt haunted with this *Spirit* of *Luxury*, and ſuch who by doing nothing, learn to do Wickedly. We muſt take Care therefore to eſchew *Idleneſs*, and to entertain our *Minds* with ſuch Thoughts, as are ſo far from being Incentives to *Luſt*, that they are deſtructive of it.

VIII. *Thirdly by avoiding the Temptation.*

Thirdly, It will be of good uſe to avoid and fly from the Temptations, which may come from the Sight of, and too free *Diſcourſe* with *Women*, leſt by handling *Pitch* we be dawbed with it. For *Luſt* is better conquer'd by *Flight*, than by *Fight*.

IX. *Fourthly an obſtinate Reſolution of Reſiſting Temptations.*

Fourthly, A full Reſolution and long contracted *Habit* and *Cuſtom*, to repel the Aſſaults and Onſets of *Luſt*, is very adviſable: For as he is eaſily overtaken with *Luſt*, who hath been often conquer'd by it; So he who makes it his buſineſs ſtrenuouſly to reſiſt its *Temptations*, becomes thereby the more ſtrong and vigorous to reſiſt them. I confeſs, it is a Maſter-piece to overcome ſo ſmiling and fawning an *Enemy*, which whilſt ſhe ruins, ſeems to Careſs us. But what is all this, if compared to our *Strength?* Nothing is impoſſible to a *Soul* that is reſolved to conquer: They are *Cowards* that upon the firſt Onſet give way, without ever putting their Strength to the Trial. But you'l ſay, It ſeems impoſſible, all on a ſudden to quit a *Habit* of long ſtanding: Suppoſe it ſo, Diſaecuſtom your ſelf by little and little, contain your ſelf for a few Days at firſt, and afterwards by degrees protract the ſaid Time, and queſtion not, but that by frequent *Fights* and *Reſiſtings*, you will at laſt become *Conquerour*. Call to mind, how great and ſincere a *Joy* thou haſt been ſenſible of, whenever thou haſt ſhewed thy ſelf a couragious Combatant, in reſiſting and putting by theſe Aſſaults; and on the contrary, how thou haſt been caſt down; what Shame, what Repentance, what Anguiſh have pinch'd and rack'd thy *Soul*, whenever thou haſt weakly and cowardly made thy ſelf a Slave to thy *Beaſtly* and *Inferiour Nature*. In a word, thou wilt ſoon be *Chaſte*, if thou canſt once heartily Will to be ſo.

X. *The Potential Parts of Temperance.*

Temperance likewiſe hath its *Potential Parts*, *viz. Meekneſs*, *Clemency*, and *Modeſty*. The buſineſs of *Meekneſs* is, to reſtrain *Anger*, and to refrain the *Mind* from *Revenge*. For by means of this *Vertue* a *Man* becomes truly *Human*, and *lovely* in the ſight of others. For as he is Hateful and Troubleſom to all, who is eaſily provoked to *Anger*; and who, upon the leaſt occaſion, becomes enflamed with *Wrath*; ſo on the other hand, we love and delight in the Company of thoſe, who, tho' highly provok'd are eaſily reconcil'd, and forgive the Injury done to them.

XI. *The Horrid Effects of Anger.*

Wherefore we muſt take care to moderate the impetuous Flame of *Anger*, and to quench it by *Meekneſs*, that we may come to our ſelves again, and recover the poſſeſſion of our *Minds*, whence that violent *Paſſion* had turn'd us out. Wherefore, as ſoon as any one finds himſelf mov'd to *Anger*, let him conſider how contrary this *Paſſion* is to *Humanity*, and how ſhamefully it diſguiſeth his *Body*, and caſts down the *Soul* from its Throne of *Power* and *Command*. Conſider the Looks of an *Angry man*; his *Eyes* flame, the *Blood* comes up into his *Face*, boyling up from his *Heart*, he Faulters in his *Speech*, his *Face* is diſtorted and dreadful; ſo that it is a great Queſtion, whether this *Vice* be more deteſtable in its Nature, or more ugly in its outward Appearance. Let a *man* conſider alſo, what a Man gains by all his *Rage* and *Wrath*; whereas by refraining his *Anger*, he delivers himſelf from this dreadful Commotion and Concuſſion, which has prov'd fatal to many, whilſt they have endeavour'd to wreak their *Spleens* upon others. How much more glorious is it, to bear *Injuries* patiently, and to contemn *Affronts*, rather than to meditate a *Revenge*; and whenever we perceive this *Enemy* creeping upon us, to have that of MARK ANTONINE the *Emperour* always before the *Eyes* of our Mind. *Behold one thing here that is highly to be valued, to Converſe courteouſly with Truth and Juſtice, amongſt a Company of perverſe and lying Men.*

XII. *Clemency.*

Clemency is near of Kin to *Meekneſs*, which is that *Vertue* whereby the *Mind* is inclin'd to Forbearance and Forgiveneſs, rather than to Puniſhment, and that according to right *Judgment*. *This is a Vertue that well becomes a Prince, who like GOD ought to be ready to Forgive the Offences of Men*; as it is expreſt *L. Imperialis de Nuptiis*. For as the Top of the *Houſe* does keep off the

X. The Potential Power of Temperance.

XI. The Horrid Effects of Anger.

XII. Clemency.

G. Freman Inv. I. Kip Sculp.

To the Worshipfull Simon Harcourt
of the Middle Temple London Esq/s.

This Plate is humbly Dedicated by Richard Blome

the Assaults of *Wind* and *Weather*; so it is the Duty of him, who is the Head of the *Government*, to provide for the Safety of the whole *Body*. *Kings* indeed have the Superiority and Dominion, but it is for the sake of *Men*; not as meer *Arbitrary Governours*, but rather as *Guardians* and *Administrators*, to whom the *Commonwealth* is committed by GOD, to cherish and defend it, and take care fot the Safety of it.

XIII. *Modesty.* *Modesty* is conversant about the moderation of the desire of *Dignity* and *Honour*. He deserves the name of a *Modest Man*, who doth not boast of his *Merits*, or vaunt of his *Endowments*; but owning himself to be a *man*, thinks lowly of himself, and esteems nothing properly to belong to him, besides that which he hath attained to. And accordingly a *Person* adorned with this *Vertue*, is more solicitous about rendring to others the *Honour* that is due to them, than desirous to receive the same from others; and is much more carried to the performing of good and great *Actions*, than concerned to obtain the name and esteem which gallant *Atchievements* bring along with them.

XIV. *The Duty of a Modest Man.* Whosoever thou art therefore, that art raised to great *Honour*, entertain no high thoughts of thy self, but being conscious of thy *Human Frailty*, and mindful of thy *Mortal Condition*, suspect and reject every thought that would flatter thee into a high conceit of thy self. A man famous for his *worth* and *merit*, and whose *Soul* is embellisht with *Vertue*, must resemble an heavy *Ear of Corn*, which sinks its *Head* by so much the Lower, as it contains a greater number of *Grains*. For the least *Boasting* lessens *Merit*; and as *praise*, coming from a *mans* own *mouth*, is nauseous, so the proclaiming of ones own *vertue*, obscures the Glory that is due to it. When CATO was asked why the *Senate* had refused to erect his *Statue* in the publick place, he answered, that by their refusal they had taken more care for his *Glory*, than they would have done in allowing him a *Statue*, for that he would much rather, that *men* should enquire why the *Senate* had not erected his *Statue*, than demand why they had *honoured* him with one in the *Market Place*. For *Honour*, like a *Shadow*, follows those that flee from it, and is most found in their company who do not pursue it. Wherefore, a *Wise Man* that placeth his happiness in the exercise of *Vertue*, is always unmoveably resolv'd, never to prefer himself before any one, forasmuch as by this neglecting of *Honours*, he both secures his own *Peace*, and acquires the most solid and greatest satisfaction. But then this *Modesty*, or rather *Humility*, must be sincere and without dissimulation; and far from that Ambitious Lowliness of some *Philosophers*, who by their despising of *vanities*, sought for vain *Honour*, and as STOBÆUS saith of them, trampled upon the Pride of others, with a greater *Pride* in themselves.

CHAP. XI.

Of Fortitude.

I. *Fortitude exceeds all other Vertues: The Definition of it.* THO' all the *Vertues* be worthily esteem'd by *Moralists*, and engage *Spectators* to love them; yet there is none amongst them all, which more insinuates it self into their *hearts* than FORTITUDE, or that shines with a more distinguishing Beauty and Lustre. *Justice* is had in great *Honour*, and the *Princes* and *Magistrates* that pursue it, do by this means attain to a high degree of *Veneration*. *Prudence* is the very *Soul* of *Statesmen*, and is industriously studied and sought for by all who have the care of *Families*, or the *Government* of a *Commonwealth* committed to them. *Temperance* hath many that praise and love her, because of the *Pleasures* she affords her followers, as well as by reason of her Comelineſs, whereby she recommends her self to the *Eyes* and *Hearts* of her very *Enemies*. But yet all these *Vertues* do in a manner vanish and disappear when *Fortitude* presents her self, as the *Stars* at the rising of the *Sun*; for her powerful Beauty, at first sight, charms and ravisheth our *Hearts*, which, as SENECA saith, consists in her not dreading the *Fire*, in her receiving of *wounds*, and being so far from avoiding the *Darts* level'd at her, that she meets them, and exposeth her Breast to them. So that *Fortitude* may be defined, *a Constant purpose of Mind to undergo Dangers, and endure Pains and Labour, when-ever we think them to be best.* Its chief *Laws* are two, the one whereby she commands us to *Undertake*, the other whereby she teacheth us to *Endure*: For seeing that this *Vertue* is conversant about *Boldness* and *Fearfulness*, which are 2 extreams of it; it suppresseth *Fear* by enduring *Difficulties*; and moderates *Boldness*, by a cautious undertaking.

II. *About what things Fortitude is conversant.* Wherefore to this *Vertue* in general, is required, *first* a kind of *Firmness* or constancy of Mind against all those *ills*, which we look upon as hard or difficult *to undertake* or *endure*. For a *man* cannot be lookt upon as possest of this *Vertue* for excelling in Bodily Strength; forasmuch as those who want that, may nevertheless be adorned with this *Vertue*, which consists chiefly in a firm purpose of performing those things we judge to be honest, and of wrestling against all *Adversities* without being discouraged by them, with an even temper and firm resolution.

III. *Who it is that deserves the name of a Valiant Man.* It hath been said already, that the *ills* which a *Valiant Man* is to cope with, must be great and difficult; for if they be matters of no trouble, they are not so much the object of this *Vertue* as of Expectation only. The *Second* thing required to *Fortitude* is, that it be not the effect of *Rashness*, but that it be done for a good end. For he is undeservedly called a *Valiant Man*, who by a blind impulse, and without any regard had to his own strength, ventures upon any thing, and who rather dares and provokes Dangers than fears them: but he, who after a due weighing of the Dangers he is about to engage in, tho' he doth not love them, yet undergoes them with an undaunted *Heart*, and endures all things when, and how it best becomes him. Hence it is that SENECA defines *Fortitude* to be *the Science of distinguishing what is Evil, and what is not.* Forasmuch as this *Vertue* is not any inconsiderate *Rashness* or *Foolhardiness*, nor a *love* or *desire* of *Dangers*, but the knowledge of undergoing and overcoming *Dangers*. So that *Fortitude* is made up of these 2, *viz.* *Honesty*, which this *Vertue* must always have for her end and aim; and *Cautelousness*, or weighing of the Danger, before she undertake to grapple with it.

Moralist

IV. *Magnanimity, Magnificence, Conſtancy and Patience are commonly confounded with Fortitude.*

Moraliſts commonly divide *Fortitude* into 4 Species, *viz. Magnanimity*, *Magnificence*, *Conſtancy* and *Patience*. But all theſe have ſo great an agreement with *Fortitude*, that they differ from it by ſome conditions and circumſtances only. For *Magnificence* imports only a circumſtance of the *Danger*, that is to be ventur'd upon, as being ſuppoſed to be illuſtrious, and to the overcoming whereof *Glory* and *Splendor* is annext. *Magnanimity* intimates that *generoſity* and greatneſs of *Soul*, which is neceſſary to the undertaking of dangerous *enterprizes*, or the enduring of Labour. *Conſtancy* implies a kind of *Perſeverance*, whereby the *mind* is confirmed to ſtick to its intended purpoſe, and never baſely or cowardly to give it over. Laſtly, *Patience* ſuperadds nothink to *Fortitude*, ſave only that it is rather converſant about the enduring of *Evil*, than in the undertaking of difficult and dangerous performances, and rather ſuffers, than acts. Wherefore not to inſiſt any longer on theſe, we proceed to the conſideration of thoſe *ills*, in the overcoming whereof the *Glory* of *Fortitude* doth chiefly conſiſt; and theſe are either Publick or Private.

V. *How Publick Ills are to be born and overcome.*

Publick Evils are, the *Deſtruction of ones own Country*, *Famine*, *Plague*, *War*, &c. which we ſhall be enabled to overcome, by conſidering that they are not *Evils* in their own nature, but are made ſuch only by our opinion of them: that *Empires* and *Commonwealths* are ſubject to Viciſſitudes, and that nothing is Eternal in this World. That we are to be affected towards *our Country*, that when we find we can no longer ſerve it, or be of any advantage to it, we do not *hurt our ſelves*; and that when we ſee the whole cannot poſſibly be ſaved, that at leaſt we endeavour to reſcue a part of it. What reaſon have we to be ſo much ſurprized and aſtoniſhed at any ſuch change, ſince it is natural for that thing to have an *End*, which had a *Beginning*. It is the Eternal decree of *Heaven*, that all *Temporal things* muſt fall, all corruptible *things* haſte away, and all changeable things periſh. We ſhall no longer be amazed to ſee a *Kingdom* overthrown, when we conſider that the whole frame of this *World* muſt be diſſolved. Wherefore when we ſee that we can no ways procure our *Countries Liberty*, let us at leaſt endeavour to ſecure our own, and that if we muſt dye with it, its ruin may oppreſs us undaunted and without puſillanimous fearfulneſs. And Laſtly, foraſmuch as we are aſſured that all things are ordered by an unerring decree of *Providence*, the *Love* of our *Country*, muſt give way to our *Love* of *God*; and our *Human Wiſdom* become ſubject and captivated to the Eternal and Infallible *Decree* of the *Great Creator* of all things.

VI. *A Man endued with true Fortitude, doth eaſily overcome Private Ills.*

As to *Private Evils*, ſuch as *Impriſonment*, *Poverty*, *Shame* or *Ignominy*, &c. tho' they may ſeem to ſome to be hard to bear, yet doth a *Valiant Man* eaſily deſpiſe them, as knowing that theſe things are only *Evil*, according to the opinion of the *Vulgar*, and that they are afflicting, becauſe we take them to be ſo. For what great *Evil* is there in a *Priſon*, that it ſhould afflict a a truly great *Soul*? Is it becauſe he is kept from the company of his *Friends*, and, as it were, excluded from the Society he is a member of? But a *Wiſe Man* knows that a wrongful *Impriſonment*, is much better than undeſerved *Liberty*; and that it is infinitely more eligible to ſuffer for *Equities* ſake, than, by wicked means, to abound with *Riches* and *Honour*. Others conſider a *Priſon*, as a *Retirement*, where, tho' the *Body* be kept in, the *Mind* may have its unreſtrained Flight, and take its unbounded *walks* in the infinite ſpaces of *Eternity*. Who would think himſelf to be a *Priſoner*, as long as he may betake himſelf to the *Market*, to the *Senate*, to *Heaven* it ſelf, and divert himſelf amongſt the *Stars*? Have not ſome writ Books in *Priſon*, and others attain'd *Learning*? If to *wicked* and *fooliſh men* it be the *Devils Houſe*, in which he keeps his *Family*; to a *wiſe man* it becomes *the School of Vertue*, where, without impediment, he dedicates himſelf to *Piety* and Probity. Why ſhould a *man* abhor a *Priſon*, who hath been conceived in a *Dungeon*, and thence borrowed the beginning of his *Life*; and who, after he is *born*, is confined to the *Priſon* of his *Body*, till it return to the *Earth* from whence it was taken?

VII. *A Valiant Man endures the loſs of outward things, and a Wiſe Man wiſhes for it.*

The *loſs of outward Goods* ſeems to inflict a deeper *wound*, which yet a *wiſe man* is very little ſenſible of; who conſiders all the things of this *World*, as the furniture of a *Lodging* in an *Inn*, the uſe whereof, for a ſhort time is afforded him, without any right of *Poſſeſſion*. The *loſs of Riches* is frequently the happy Mother of *Peace* and Quiet, and a *Tranquility* of *Mind*, which is ſeldom enjoy'd but by a *Soul* free from *Earthly Cares*. ZENO, the *Father* of the *Stoicks*, called that day the happieſt day of his *Life*, wherein he loſt all his *Goods* by *Shipwrack*, and profeſt himſelf extreamly engaged to thoſe *Winds*, which, by daſhing the *Ship* wherein his Eſtate was contained, againſt the *Rocks*, had driven him into the ſafe *Haven* of *Philoſophy*, where he ſpent the reſt of his *Life* at the furtheſt diſtance from the *Storms* and toſſings of this *World*. A truly *Valiant man* therefore knows that he hath no Right to any of theſe *outward things*; no more than the *Earth* can lay claim to the *Light*, which ariſeth and diſappears again in a moment. He calls to mind, that all the conveniencies he enjoys here are the Divine *Benefits*, which as they are freely granted, ſo are they taken away again, for juſt tho' hidden cauſes.

VIII. *The loſs of a Good Name or Repute may be eaſily overcome likewiſe.*

But your *Enemies* take away your *Good Name*, and endeavour by all means imaginable to obſcure and blacken your *Reputation*. Neither can this reach any but weak and Puſillanimous Perſons, who not conſidering the *Talkativeneſs* of wicked and perverſe men, are too much concern'd with their *Babbling*. But the *man* that is poſſeſt of true *Fortitude*, undervalues all theſe things, and as he deſpiſeth *Pride*, ſo he is little concern'd at what *men* ſay of him, as long as he is conſcious to his own *Probity*: He is a ſufficient *Theatre* to himſelf, who eſteems it to be a *Kingly* part to *do well*, and to be *ill ſpoken of*. Was there ever any Good *man* that eſcaped the *Slanders* and *reproaches* of men? The Tongue of *Backbiters* creeps in every where, not ſparing *Sanctity* it ſelf. Let every one therefore that is aſſaulted by the *Tongues* of malevolence conſider with himſelf, whether he be guilty of the *Evil* that is reported of him, or not; if he be not, what reaſon hath he to be concern'd at the imputation of this *Slanderer*, or to vex himſelf, becauſe

G. Freman. In. I. Kip. Sculp.

To the Worship= =full Henry
Portman of Orchardiny
County of Somerset Esqr.
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becauſe a malevolous perſon uſeth the liberty of his *Tongue*, and complies with the perverſeneſs of his own Nature? But if he be guilty of the Reproach laid at his Door, let him immediately take occaſion thereby to amend his *Fault*, and by changing his *Life*, prevent, as much as in him lies, all occaſions of *Reproach* for the future. Let him ſeriouſly conſider, that all that is ſaid is without him, and cannot enter his *Breaſt*, except that he himſelf admit it, ſince no man is, or can be offended but by himſelf.

IX. *How all other Evils are to be obviated by us.*

And becauſe the limits I have confin'd my ſelf to, do not allow me to reckon up all particular *Evils*; I ſhall only preſcribe this general *Remedy* for them all; that a *man* throughly perſuade himſelf, that the *Peace* and *Tranquillity* of his *Mind* doth not depend on *Riches*, *Honours*, *Friends*, *Health*, and other good *things* ſo accounted; ſince many are miſerable notwithſtanding the enjoyment of all theſe, and many are happy without them. How inconſiderable is the loſs of *Mony* to him, who hath laid up his *Treaſure* in *Heaven*? And how little is he concern'd with being baniſht from his own *Country*, whoſe *Heart* is fixt on a *Heavenly*? What hurt is it to have ones *Body* bound, as long as the *Mind* is at full liberty? A truly valian *man* is always the ſame; and as a Hand that is ſpread, or clutch'd into a *fiſt*, continues ſtill the ſame *Hand*; ſo he bears the ſame *Mind*, and looks too, in the bluſtering dark *Storms* of *Adverſity*, as in the ſerene *Sunſhine* of *Proſperity*: For *Death*, *Diſeaſes*, *the loſs of Goods*, *Fame and Friends*, and other ſuch-like that appear ſo terrible to ſome, are the *Tributes* due to *Nature* or *Fortune*, and are to be paid by us, whenſoever they are demanded. How much more glorious therefore is it, to put a difference between our *Soul* and *Body*, and to keep our *Soul* free and unconcerned, tho' our *Body* be pain'd with *Aches*, ſhut up in a *Dungeon*, torn by an *Executioner*, and aſſaulted by *Death* it ſelf.

X. *Some kinds of falſe or ſeeming Fortitude.*

As there are 4 kinds of true *Fortitude*, ſo there are 5 of that which is Falſe and Appearing. The *Firſt* whereof is the *Political* or *Civil*, which by fear of *Puniſhment* or *Shame*, or the hope of *Honour*, prompts *Citizens* to the undergoing of *Dangers*. 2ly. *Military*, whereby men relying upon their *ſtrength* or skill, or for hope of reward, caſt themſelves upon hazarding their *Lives* and *Limbs*. 3ly. *Angry* or *Wrathful*, whereby *men*, inflamed with *Anger*, venture upon the moſt deſperate and dangerous attempts. The 4th. is *Experimental*, being proper to thoſe, who having eſcaped many great and eminent *Dangers*, are confirm'd in a hope of a like good luck in the moſt dangerous undertakings they ſet upon. The 5th. is a *Blind* and *Ignorant* *Fortitude*, whereby *men* continue undaunted, becauſe they are not ſenſible of the danger they are in. But none of all theſe is that true *Fortitude*, whereof we treat here; for a truly valiant *man* acts wittingly, knowingly, conſtantly, only out of *Love* to *Vertue*.

CHAP. XII.

Of Juſtice.

I. *Of the Nature of Juſtice, and whence it hath its Riſe.*

THO' JUSTICE be eſteemed the Splendor of all other *Vertues*, and the Root of all *Duties* or *Offices* whatſoever, yet doth it derive its excellency only from the *Corruption* of *men*, and takes its riſe from their *Vices*. For as we muſt firſt diſcover the *Diſeaſe*, before that we can be in a condition to *Cure* it; ſo *Laws* are made uſe of for a Check and Curb to *Vices*, and to bind depraved *mankind* to their good behaviour. For *Juſtice*, according to the account the *Lawyers* gives us thereof, *is* nothing elſe but *a conſtant and perpetual Will of giving to every man his due*, *L.* 10. *F. de Juſt. & Jur.* By the word *Will*, in this definition, we do not underſtand that *Faculty* of the *Mind*, whereby it determinates it ſelf to act, and aſſents to a thing clearly perceived by it, but rather the *Affection* or *Purpoſe* of conſtantly exerciſing *Juſtice*. Becauſe he is not ſaid to be *Juſt*, who ſimply doth that which is *Juſt*, when his chief motive is either *Fear*, or to obtain the favour of *Friends*, or the hope of *Reward*, or other ſuch like; but he only who performs ſuch *actions* from his own free will, and out of Love to *Juſtice*.

II. *The Will or Purpoſe of a Juſt Man, muſt be perpetual.*

It is alſo added, that this *Will* or *Purpoſe* muſt be perpetual; for it is not ſufficient for obtaining the Title of a *Juſt Man*, now and then to render to another his due; but it is of abſolute neceſſity that he be in full and conſtant Reſolution of doing the ſame whenever occaſion ſhall offer.

III. *Two things are required to the exerciſe of Juſtice.*

There are 2 things wherein the whole requiring or duty of *Juſtice* is contained; the firſt whereof is *to do Good*, that is, to pay ones due; and the other to *avoid Evil*, that is, to hurt no body, and to decline all thoſe things that may prove hurtful or incommodious to others. Not as if this latter part of *Juſtice* did conſiſt in not doing any harm, but in a deſire of the *Mind* to keep off evil from others, and to remove it as far as lies in our Power.

IV. *The Diviſion of Juſtice into Legal and Special.*

Juſtice, univerſally conſidered, is divided into *General* or *Legal*, and *Special*. *General* is that which conſiders the *Good* that is common to many; and its buſineſs is to make good *Laws*, and obſerve them when they are made. So that its *Object* is not every *Good* that is common to many, but that which conduceth to the advantage of the whole *Commonwealth*. Special *Juſtice* is that which we have before defined to be *a Firm Will of giving every one his due*, or a *Vertue* inclining the *mind* always to render to every *man* his Right, and that according to *Equality*.

V. *Juſtice divided into Commutative and Diſtributive.*

Special Juſtice is ſubdivided into *Commutative* and *Diſtributive*; whereof the former is converſant about *Compacts*, *Exchanges*, and *Contracts*; but the latter conſiſts in diſtributing *Rewards* or *Puniſhments*, amongſt thoſe that are the *Members* of a *Civil Society*. The former of theſe conſiders *things*, and the latter *Perſons*; the firſt belongs to *all*, the ſecond only to *Princes* and *Magiſtrates*.

VI. *Theſe two ſorts of Juſtice are diſtinguiſht from their End.*

They are alſo diſtinguiſht by their *End*, becauſe the *end* of *Diſtributive Juſtice* is to conſtitute an equality between Proportion and Proportion; ſo as that there may be the ſame *Proportion* between the *things* that are diſtributed, as there is between

between the condition of the *Persons*, to whom the Distribution is made. As for Example, when after a *Victory* obtained, some *Rewards* are to be distributed according to the desert and condition of the *Persons*; here an exact regard must be had to the *merit* and *dignity* of each, so as that the *reward* which is given may be greater or less according to the *Dignity* or *Worthiness* of the *Person*. But in *Commutative Justice*, the equality only of the *thing* received and rendred is considerd, so as that the return must be equal, according to *Arithmetical Proportion*, to that which hath been received, without any respect had either to *Merit* or *Person*.

The following *Vertues* are annexed to *Justice* as its Species, *viz.* *Religion*, *Piety*, *Observance*, *Friendship* and *Gratitude*.

VII. *What Religion is.*

Religion is the Top and Principal of all *Vertues*, whereby we worship and honour *GOD* with the highest *Love* and *Veneration*. For this must be the chiefest affection of *Man* to adhere firmly to his *Author*, and to own him as the *principle* of all *Good*. For the first business of *Religion* is to discover *GOD*, as far as human Frailty will permit, and to persuade *Men* that he is, or doth exist. For the *due worship and honour* we pay to *GOD*, is derived from the knowledge we have of him; that is, that we are certain that the *World* was made by him, and *Rul'd* and *Govern'd* by his peculiar *Providence*. And in the next place, that nothing happens to us without his command or permission; so that all things are design'd for our *Good*, and whatsoever befalls us, must be believed to have a tendency to our *Salvation*. For seeing that his *knowledge* is most perfect, his *Power* infinite, and his *Will* most *Loving* and *Beneficent*, it is impossible that any thing should befall us, at his disposing, but must needs be for our *Good*. And tho' we cannot always perceive or understand this, yet we are to consider him as a *Physician*, who oft displeaseth his *Patient*, and puts him to *Pain*, that he may heal and make him sound.

VIII. *We must resign and submit our selves with all our concerns to GOD.*

Relying upon this *assurance* we must submit all our concerns to him, and acknowledge that we are come into this *World*, not to prescribe *Laws* to others, but to follow those that are already established, and to yield a strict obedience to those which we are surely persuaded proceeded from him. *Moreover* we are in such a manner to order our *Prayers* we offer to him, as that we may obtain what is consonant and agreeable with this *Providence*, and to what he hath from Eternity decreed should come to pass. For he attempts, as it were, to corrupt the great *Judge* of all the *World*, who begs any thing of him, but what is the purpose of his *Will*. And above all things we are to remember, that we can never offer any more *acceptable Prayers* to him, or *profitable* to our *selves*, than those whereby we entreat him to moderate and subdue our *Affections*, and to captivate and overrule our *Will*, that we may always embrace what is *best*. We must also be assured and fully persuaded, that no *Sacrifices* are more pleasing to him, than such as proceed from a *pure Heart*, and which are accompanied with an *Innocent Life*. Let us therefore consecrate and dedicate our *Minds* to be his *Temple*, where we may offer *Sacrifices* to him, breath forth our pure *Affections*, and present to him the *Oblations* of our *Love*, *Worship*, *Veneration* and *Subjection*. And after we have done all this, let us not be ashamed to make a frank and open profession, that we have done nothing worthy of his *Divine Majesty*, or that is worth his acceptance.

IX. *Piety or Love to our Country.*

Having given to *GOD* the *Honour* due to him, we must proceed to the *Reverence* that is due to *Parents*, who are the *Channels*, whereby we have been conveighed into this *World*. And under this notion *our Native Country* first presents it self, which under a feigned name requires a true *Love* of us; forasmuch as of all *Societies* and *Fellowships*, as *CICERO* saith, none is more grateful and pleasing, than that which we have with the *Commonwealth* whereof we are *Members*. Our *Parents* are Dear, our *Children*, *Relations* and *familiar Friends* are Dear, but it is our *Country* alone that comprehends all these *Endearments*, for which no good *Man* would make any question to hazard his *Life*, to procure its *Weal* and *Happiness*. Indeed our *Country* contains all that is near or dear unto us, so that as long as that is safe, they are so too, but if that miscarry, all these are lost together with it.

X. *Observance to Parents.*

Next to the *Love* we owe to our *Country* follows the observance and *Love* which is due *to our Parents*, who by special *Providence* have been destinated to bring us into the *World*, and who have been in stead of *GOD*, by imparting Life to us. Who, if they be *Godly* and *Vertuous*, deserve a double *Honour* at our *Hands*, as promoting and leading us by their *Example*, *Exhortations* and *Precepts*, to *Vertue* and good *Manners*, and make it their utmost endeavour that we may be *Happy* in this *Life*. If they be *harsh* and *perverse*, yet we must always remember that still they are our *Parents*, and that we are beholden to them for our *Lives*. And accordingly by natural instinct we are led to relieve our *Parents* whensoever they are reduc'd to any *necessity*; and for the saving of them, not only to hazard the loss of all we have, but also of our very *Lives*. *Heathens* have done no less, who with the danger of their own *Lives*, and neglecting their *Riches*, have only made it their business and care to save their *Parents Lives*. Hence it was that *ÆNEAS* obtained the name of *Pious*, for having carried his *Father* safe out of the *Flames* of *Troy*, and through the midst of his Enemies, *Æneid.* 6.

Him I through raging Flames did on my Shoulders bear,
Through Armed Troops, and Darts that clogd the Air.

Let us not disdain herein to imitate a *Heathen*, and to learn from those who by the sole instinct of *Humanity* exposed their own *Lives*, to save their *Parents*.

XI. *Observance towards Superiors.*

Observance is a *Species* of *Justice*, whereby we *Honour* and *Reverence* those that are our *Superiours* in *Age*, *Condition* or *Gifts*; for to all these *Honour* is due, as a reward of their *Labor* and *Dignity*: For seeing that they take care for the *publick Good*, and endeavour to promote the *Happiness* of their fellow *Citizens*, nothing can be rendred to them in lieu hereof but Honour and Respect; for should they demand any thing else, they would be so far from being honourable, that they

they would appear to all, to be mean and covetous.

XII. *Friendship between Equals.* Forasmuch as *Friendship* is a kind of Equality, it must also belong to *Justice*, as being nothing else but a mutual *Benevolence*, by which some persons mutually desire to do good to each other. This is the best of those things that can be obtained in this *Life*, as being the ground and foundation of our *Happiness*. This is that which takes away all the bitterness of this *Life*, and exalts all the sweets and *pleasures* of it. In *Prosperity* it furnisheth us with an object for our *Beneficence*, in *Adversity* and *Misery* it affords us an object which we may relieve and comfort. *Friendship* teacheth us when we are *young*, comforts and cherisheth us when we are *old*, and being never forgetful of her Duty, doth at all times help and assist us. Wherefore it is only to be lookt for amongst *good* Men, and they only are to be beloved with this *Love* of *Friendship*, whom of a long time we have known to be honest *Men*, and are far more considerable for their *Vertus* than for their *Riches*: And accordingly we are to endeavour to gain such as these by all occasions, and to preserve their *Friendship* when gained by all good Offices.

XIII. *Gratitude or Thankfulness.* *Gratitude* is a *Vertue* that preserves a pleasing and acceptable *Memory* of *Benefits* received. This part of *Justice* seems to comprehend all other *Vertues*, forasmuch as no *Man* can be *Pious*, *Friendly* or *Observant*, that doth not live in the exercise of *Gratitude*. For what else is *Piety*, according to *TULLY*, but a grateful *Affection* and *inclination* towards our *Parents*? Who are *good Citizens*, and deserve well of their *Country* both at home, and in the *Wars* abroad, but such as are mindful of the *Benefits* they have received from their *Country*? Who are *Holy* and *Godly*, but those who with a thankful *Heart* and *Mind* full of acknowledgement, give GOD the *Glory* of all his *Benefits*? What *Pleasure* can there be in this *Life* without *Friendship*? And what *Friendship* can there be betwixt ungrateful *Men*? Who amongst us, that hath been liberally educated, doth not with Joy and Gratitude entertain the *Memory* of those who have educated us, and been our *Masters* to instruct us in good *Literature* and *Manners*? Who is, or ever was so *Rich*, that his Wealth was equivalent to the *Love* and good *Offices* of *many Friends*? Which cannot subsist without *Gratitude*, and a thankful remembrance of *Benefits* received. Wherefore it is the Duty of every one to endeavour to carry himself thankful towards all, and never to forget any *Kindness* done to him, if ever he desire to please and satisfie himself or others.

There be also some other *Vertues*, that are contained within the compass of *Justice*, *viz. Charity*, *Humanity*, *Civility*, *Affability*, *Hospitality* and *Liberality*.

XIV. *Charity.* *Charity* is that *Vertue* which incites us to *Love* all *Men*, and to succour and relieve them according to our ability. For seeing that the Happiness of this *Life* consists in *Action*; we are not only to bear a good Will to our *Neighbours*, but must endeavour to assist and help them by our *Works* and *Actions*. For as the *Sun* is beneficial to all, and doth not pick and choose some only, to whom he may communicate his *Light*; so likewise must our *Love* be extended to all, and being dilated by this *Vertue* of *Charity*, embrace all, and do good to all.

XV. *Humanity.* *Humanity* is that *Vertue* whereby with a kind of *Benevolence*, we express and testifie to all *Men* our readiness to serve and oblige them, from a due sense of the *Dignity* of *Man*, and our common Bond of *Consanguinity*.

XVI. *Civility.* *Civility* is a *Vertue*, whereby a *Man* from the Sense of common *Humanity*, doth speak courteously to all those that have any business with him, or that he meets with; and makes use of such *Words* and *Gestures*, as do express a kind of *Benignity* and *Benevolence*.

XVII. *Affability.* *Affability* is that *Vertue*, whereby a *Man* in his discourse with others, as well by his readiness and easiness to hear, as by the sweetness and agreeableness of his *Speech*, doth gain the *Hearts* of those he hath to do with.

XVIII. *Hospitality.* *Hospitality* is a *Vertue*, which makes us kind and obliging to *Strangers*, by giving them kind and free *Entertainment*; not only because they are *Men*, but because being Strangers and out of their own *Land*, they may want many things, which at home and in their own *Country* they plenteously enjoy.

XIX. *Libtrality.* *Liberality* is a *Vertue*, which prompts us to be beneficial to others, freely and spontaneously according to our Abilities. This *Vertue* hath 2 extreams, for if our *Beneficence* be deficient, that is, less than it ought, we deserve the name of *Covetous*; but if we exceed in our *Gifts* and *Kindnesses*, so as to give more than we ought, to others, then we ought, or at another season, or for other reasons than we ought, we fall into a *Vice*, and are justly called *Prodigal*. And accordingly, saith *CICERO*, those *Men* are *Prodigal* who by *Feastings*, *Doles* and *Shews*, or by the vast charges of *Plays* and *Publick Huntings*, squander away their *Mony* upon such things, the memory whereof is either none at all, or very short lived. But such are truly *Liberal*, who redeem *Slaves*, pay the *Debts* of their *Friends* or *Poor Men*, or assist them in the bestowing of their *Sons* or *Daughters*, or for the getting of an honest livelyhood.

CHAP. XIII.

Of the usefulness of the Passions or Affections of the Soul.

I. *The Opinion of the Stoicks.* FOrasmuch as the *Vertues* do arise from the *Affections* of the *Soul*, and that they are wholly conversant and taken up about the *Ruling* and managing of them, I should be wanting to the design of this Discourse, if I did not examin the usefulness of them, and shew how many several ways they may be advantageous to *Men*. It is very notorious with what Virulence the *Stoicks* inveigh against the *Passions*, who being too solicitous for the Tranquility of their *Wise Man*, have supposed them to be altogether Evil, and therefore to be avoided by him, whom they will have to be exempt from all *Vices*, and not subject to any Perturbations. I confess my self formerly to have pleaded their Cause in my *Discourse* entitled, *L'Homme sans Passions*, and not only to have maintained *SENECA'S* Opinion, but also according to my slender Ability, endeavour'd to advance and exalt it. But forasmuch as I now follow the sentiments of *DES CARTES*, and

my

my business is not to explain the *Opinions* of others, but only to lay open *Truth*, no understanding man will reproach me of Lightness or Inconstancy, for going about to unfold the usefulness of the *Passions*, and leaving the *Stoicks*, consider *Man*, not as Translated amongst the *Glorified Saints* in *Heaven*, but as placed amongst his *Mortal Brethren* here on *Earth*.

II. *Vertues without the Passions are weak and languishing.*

For the clearing of what I intend to deliver on this Point, it will be of use to call to mind that the *Passions of the Mind*, are certain Sensations or Perceptions of the *Soul*, which have a *special Relation* to the same, and are produc'd and maintained by the motion of the *Spirits*: As hath been declared more at large, in the foregoing part of this *Institution*. Now it is apparent, that these *Commotions* of *Mind* do greatly assist, corroborate and invigorate all *Human Functions*. For doth not daily experience teach us, that all *Human Actions* are dull and liveless without them, and that the vigor of the *Mind*, where they are absent, ceaseth and fails? *Reason* it self in many cases appears dull and heavy, if it want the brisk company of *Affections*, and becomes stupid, when not excited with the *Spurrs* and *Goads* of the *Passions*? Where shall we meet with *Fortitude*, that undertakes the most hardy and difficult attempts? Which pursues *Dangers*? Which *dares* and *provokes* the most terrible *Evils*, except it be assisted by *Anger*, which excites it to revenge the injuries and affronts done to ones *Country*, *Parents* or *Friends*? *Prudence* perisheth, where *Fear* is wanting to put it upon making provision for the Future: For it is this Monitor puts *Prudence* in mind of what *Evils* may happen, how she may obviate them, and by what means repel them? Who ever attempted any thing that was Great or Generous, without a strong and exalted *desire*? What Eminent *Orator*, or Famous *Philosopher* ever conceived or brought forth, any thing that was Rare and Excellent without it? Why are so many toilsome and expenceful *Travels* undertaken, to visit unknown *Nations* and *Countries*, but from an *ardent desire* of *Seeing* and *Learning* things unknown? Who loves *Vertue*, that is not accompanied with *Joy* and *Gladness:* For bare and naked *Vertue* is neglected and despised, except it promise, and actually bestow pleasure and satisfaction upon its Followers.

III. *Two things are required to make the Affections good.*

The *Affections* therefore are good, and contribute to the Perfection of *Human Life*, as long as they observe these 2 following *Rules*. *First*, that the *Object* they are conversant about be *lawful*: For Affections seem to have been bestowed upon us by the *Author* of *Nature*, that they might excite us to the pursuit of *Vertue*, and the declining of *Vice*. The *Second* is, that our *Passions* be proportioned to their *Objects*, and comport with the *Light of Reason* in all their *motions*. For such is the force and power of *Reason*, that it throughly searcheth into, and contemplates the nature of *Objects*, perceives the *Qualities* of each of them, and distinguisheth them from others: He who follows her, is safe and secure from Error, and forearmed against all deceptions whatsoever. So that he has his *Ears* open to the instructions of *Reason*, who loves the best Good with the Highest love and *Affection*, and all other things according to their several degrees of worth and merit.

IV. *Passions are useful to the Actions of Life.*

The *Passions* therefore are very useful to the *Actions* of *Human Life*, as long as they are subject to the command of *Reason*, and attempt nothing contrary to its *Dictates*. For they are the Master of *Vertue*; and as *Fire* becomes extinct, when it wants *fewel*, so without the *Affections* *Vertue* remains idle, and unactive. For what great thing can it ever attempt, as long as it continues fixt in its own mean or middle Point, and is not spurred on by the *Passions*? As long as the timorous *Thoughts* of *Human Wit*, are not excited to some choice or other? As long as *Fortitude* is not stirr'd up to gallant *Actions*? As long as *Justice* is not Arm'd with her *Sword*? And lastly, as long as *Temperance* is not kept within its due bounds by *Fear*, *Shame* and the *Emulation* of our *Perfidious Nature*? How are all *Human Functions* over-whelm'd with a deep Sleep, where for want of the *awakening motion* of the *Passions*, *Men* are not rowzed from *Rest* and Idleness, to Briskness and Activity?

V. *An Objection against the usefulness of the Passions.*

But you'l object that most of the *Passions* are *Evil*, and lead us headlong to *Vice*: For as they break forth suddenly upon the *Soul*, so they hurry her away without expecting the advice and counsel of *Reason*, and reduce her to the blind and wild condition of *Beasts*; like unruly *Horses* that will not be restrained, running headlong into the *Precipices* of unlawful *Lusts*, accursed *Envy* and *Hatred*, and mad *Superstitions*.

VI. *The Objection answered.*

To which I answer, that what I have said concerning the usefulness of the *Passions*, must only be understood of them, in asmuch as they are subject to the command and guidance of *Reason*, and proportion'd to their *object* and *end*; which then only takes place when those things are *Loved* that ought to be *Loved*, and when such *Objects* are loved in a higher degree, which because of their greater worth deserve more of our *Love*. For *Love* and the rest of the *Affections*, are never *Evil*, as long as they keep within their Bounds, and pursue only those *Objects*, that are agreeable to *Reason*. But as there are some *Passions* that are of no use at all to Men except they be moderated, and reduced to Mediocrity, to the end they may be subservient to the acquisition of *Vertue*: So some of them are so very good of their own Nature, that the more they exceed the better they are; for in asmuch as they always follow the Guidance of *Reason*, they cannot but be upon all occasions, fruitful and advantageous.

VIII. *A twofold excess is to be considered of in the Passions.*

For there is a twofold excess in the *Passions*, the *one* whereof changeth the nature of a thing, and of *Good* makes it become *Evil*, and by this means hinders it from continuing in subjection to *Reason*. So we find that some *Affections* do to that degree oppose the motions of *Reason*, and depress the force of the *Mind*, that being wholly abandon'd by it, they degenerate into down right *Vices*. The *other* excess is, whereby the degree or measure of the *Passion* only is encreased, and of a Good one is made Better. Thus *Boldness*, or as others rather express it, *Rashness*, is not said to be an excess of *Fortitude*, save only when it transgresseth the Bounds of *Reason*. But yet *Fortitude* is also capable of another kind of Excess, even whilst it continues within the said *Bounds*; which consists in this, that it is not subject to be shaken or moved by any Doubt or Fear: Which Excess is so

so far from being Blame-worthy or Reproachful, that the Tongues of all *Orators* are not sufficient to extol and commend it, this being the peculiar *Vertue* of *Heroes*, whom the *Antients* ranked amongst the *Gods*.

CHAP. XIV.

What is the use of Wonder or Admiration.

I. *Some condemn Admiration.*

MOST of the *Antients* had but a mean esteem for *Admiration*, as looking upon it to be the Vice of Ignorant *Persons*; and therefore took it to be an *Enemy* to *Human Felicity*, and the fruitful Mother of *Sorrow*, *Fear*, *Desire*, and other *Passions* that are the Tormentors of *Mankind*. And accordingly HORACE supposeth that *Men* would be exempt from all these, if once they could leave their wondring, *Lib. 1. Epist.*

Nothing t' admire is th' only thing that can
Make and preserve a Blest and Happy Man.

II. *Wonder or Admiration is necessary for the acquiring of Sciences*

But these *men* do not seem to have rightly understood the nature of *Admiration*, but rather to have confounded it with *Fear*, which beholds every thing with *Trembling*, and is affrighted at all the unusual *Objects* it meets with. But forasmuch as *Admiration* is nothing else but a *suddain Occupation of the Mind, whereby it is strongly carried to the attentive consideration of those Objects, that appear rare and strange unto it*, no *body* can deny but that it must needs be very conducive to the *Learning* and *Remembring* of those things we were ignorant of before. For it is evident, that there are chiefly 2 *Principles* which concur to the invention of every Art, *viz. Admiration*; because as soon as any new thing is suddainly presented to our *Understanding*, our *Mind* is presently struck with *Admiration*, and is powerfully rowzed to the searching into the Nature of it; and *Experience*, because the *Mind*, being allured by the *Admiration* of a Rare and Uncommon *Object*, never rests till it have found by Experiment, what the Nature of it is, and the Cause of it. So they who first observed the *Eclipse of the Sun*, being seized thereat with extraordinary wonder, it ingaged them to search into the Cause of this unknown *Effect*, till after many repeated *experiments*, they found that the same was caused by the *Moons* moving between the *Sun* and the *Earth*; whence they gather'd this *Proposition* of certain and undoubted *Truth*, that *a Solar Eclipse is produced by the interposition of the Moon betwixt the Earth and the Sun.*

III. *Those who are not apt to Wonder, are generally unlearned.*

The necessity of *Admiration*, in order to the attaining of *Knowledge*, is very apparent from this one instance, that commonly those who are destitute, or not apt to be touch'd with this *Passion*, are commonly unlearned, and very ignorant. For, notwithstanding that many things present themselves to our *Understanding*, or offer themselves to our *Senses*, yet will they never be fixt in our *Memory*, except by some *Passion* they be impresst in our *Brain*, or by the intent application of our *Understanding*, being determined by our *Will* to a serious Attention. For rare and unusual *Objects* encrease our *Attention*, because by their Novelty they leave a deeper impress of themselves; and the *Spirits* flowing thither, do encrease the application of the *Mind*; by which means we frame more lively and lasting *Idea's* of *things*. Moreover, *Admiration* is of great use for our attaining of the *knowledge* of *things* which formerly we were ignorant of: For a *Man* that is seized with *Admiration*, compares the unknown *Object*, with things that he hath formerly known; by which means he sees it to be different, and enquires why it differs from them. Hence it is that *Admiration* is called *the Beginning of Philosophy, the Seed of Knowledge*, and *Abrupt Science*. *To admire*, saith PLATO, *is much the Affection of a Philosopher; neither indeed can any other Original or Beginning of Philosophy be assigned but this.*

IV. *The Esteem and due Value of ones self, how it may be profitable.*

The esteem of ones *self*, which is a Species of *Admiration*, is conducive to every *man*, in as much as it shews him, that he hath something that is his own, and possesseth some *Perfections*, in consideration whereof he may respect and love himself more intimately than all other things. For *Self-Love* is a Lawful *Affection*, it being allowed to every *man* to consider himself before others. Moreover, a *man* by loving himself, imitates GOD, who, like a *Circle*, turns into, and terminates in himself, and loves himself with the Highest and Essential *Love*. This is the Property of *Wise Men*, who, subduing all foreign *things* to their *Mind*, do so highly esteem the dignity thereof, that they account it the highest Sacriledge to defile it with filthy and vain *thoughts*. Hence it is that they have an awful regard for themselves as for *Deities*; and abhor to commit any thing that might make their *Consciences* to condemn them. And to this purpose ARISTOTLE in the Second *Book of his Politicks*, proves that a due *Esteem* of our selves is a *Vertuous Quality*; and if at any time *Self-Love* is blamed, that is only so far as it exceeds its Bounds, and makes us to *love* our selves over-much.

V. *The undervaluing of ones self is a great help to Humility.*

On the other hand, the *Contempt* or Low esteem *of ones self*, by which a *man* despiseth his own *worth* and *merit*, is very conducive to *Humility*, and makes him refuse the *Honour* others render to him. This *Vertue* teacheth him, that the *praises* of others are useful to him, as long as he continues vile in his own *Eyes*; and that he is not to mind what others say of *him*, as long as he is conscious to his own *defects* and *meanness*, and that he wants those very *Vertues* which others extol him for. This *Passion*, moreover, hath this good *effect*, that it makes us to despise no *man*; but owning our selves to be *men*, prompts us to measure their *Vices* with the same Equity wherewith we censure our *own*. For it is but Reasonable and Equitable, that knowing our own *weakness*, we should take *pity* on others, and according to the command of *Charity*, think better of them than of our selves: For indeed what do we know, but they may far exceed us in *Vertue*? and tho' they have fallen as *Sinners*, yet may have risen again as *Saints*. We may lawfully contemn our selves, but cannot despise any other without *Sin*, and being injurious to our *Neighbour*.

VI. *Veneration teacheth us, to respect every one according to his Merit.*

VENERATION, whereby the *Soul* is engaged to esteem the *Object* it respects and honours, and to subject it self to the same, teacheth us to Reverence those *Powers* that are above us, and to render unto them the *Honour* that is their due.

due. For seeing that *Authority* is various, and that the *Persons* that are above us, are not all of them of equal *Dignity*, *Veneration* prompts us to *honour* every one of them, according to the different *Power* and *Order* they have in the *World*, rendring them a various *Respect* and *Worship*, according to the difference of their *Merit* and *Dignity*.

VII. *Our Parents.* In the *first place* therefore, it puts us in mind of the *Reverence* we owe to our *Parents*, as to GOD's *Vicegerents*, who have brought us forth into the *World*, who with anxious and sollicitous *care* have educated us, who have instructed us in the *Duties* of *Religion*, framed us to *Vertue*, and furnisht us with *Knowledge* and *Learning*. For since it is most agreeable to *Nature*, to *Love* those who *Love* us; how great is that *Love* which we owe to our *Parents*, seeing that our *Love*, be it never so intense, will not equal their most tender Care and good Will towards us?

VIII. *Magistrates* In the next *place*, it adviseth us to *honour Magistrates*, and such as are in *publick places* of *Trust* and *Authority*. For seeing that they watch for the *Weal* and *Welfare* of the *Commonwealth*, and are set over the People, to the end they may assist and help them, procure their safety, and secure their *Estates*, they certainly deserve *Honour* and Respect from all whose happiness and welfare they contribute to.

IX. *Wise men.* This *Affection* also teacheth us to *Honour* and esteem those that excel in *Wisdom* and *Vertue*, and do recommend them, by the *Examples* to all others.

X. *Disdain.* Neither is the *Passion* of *Disdain* altogether useless, whereby the *mind* of *man* contemns some *persons*, and accounts them so much below it self, as to know that it is not in their *Power* to do him either *Good* or *Evil*. For this *Passion* is not a little conducive to the *Quiet* of the *Mind*, by raising it above the reach of any *Mortal Power*, making it to be unconcerned at their *Promises*, and fearless of their *Threats*. Especially in cases where the Cause of *Vertue* is to be appear'd for, or *Vertue* to be maintain'd.

CHAP. XV.

Of the End or Usefulness of Love and Hatred, and the Interpretation of them.

I. *Love teaches us to do good to others.* IT is an in-born instinct of the *Will* of *Man*, to *desire* that which is *Good*, and to testifie its displeasure, when it cannot attain it. Thus we see that a *Covetous Man* desires *Riches*, and an *Ambitious Person* pursues *Honours*, because they look upon these things as Good for themselves, and are with earnest desire carried towards them, as to things perfective of their *Nature*. For *Love* is nothing else but *a Thought or Cogitation of the Mind, by which it is stirred up to join it self in Will to those Objects which appear agreeable to it*. So that this *Passion* puts us in *mind* to do good, not only to *our selves*, but to *others* also: Forasmuch as all *men* are united to us by a likeness of *Nature*, and constitute but one *Politick Body* or *Society*; wherefore also we are drawn by a natural impulse to bestow *Benefits* upon them, and to procure their profit and advantage, as far as lies in our way. For *Love* is a *Beneficent Passion*, and rejoyceth to diffuse it self, to a vast variety of *Objects*. Hence it is that PLATO feigns it to be the *medium* between that which is Deformed or Ugly, and that which is *Beautiful* and *Lovely*; between that which is *Mortal* and that which is *Immortal*, because it cherisheth and maintains *Human Society*; and joyning contraries together, links the *Proud* with the *Humble*, and the *Poor* with the *Rich*. We shall therefore make a good use of this *Passion*, by assisting and relieving our *Neighbours*, and by desiring and promoting the *good* and *welfare*, not only of our selves, but of others also.

II. *And to hurt no Body.* But forasmuch as some, under pretext of helping their *Neighbours*, do *injure* them: The Interpretation of this *Affection* is, that in doing *good* we take care that we be not hurtful or prejudicial to any: but that we assist them willingly and heartily, and endeavour to promote their good from a pure instinct of *Charity*, and be to them as *Light* which penetrates all *Diaphanous Bodies*, without any hurt or prejudice, either to them or it self.

III. *Devotion excites us to love GOD.* By *Devotion*, which is a *Species* of *Love*, whereby the *Lover* esteems the Beloved Object more than himself, we are taught to *love* GOD, and embrace him with the utmost extent and strength of our *Affections*. To which *Divine Love* we may arrive, by considering that GOD is a *Spirit*, or a *Thinking Being*, upon which account, seeing that our *Soul* is of affinity with his *Nature*, we are persuaded to believe, that it is an Emanation from his Supream *Intelligence*, and, as it were, a *Particle of the Divine Breath*. Moreover considering the *Immense Power* whereby he *created* the *World*, and all the things that are, without any *præexistent matter*; the *infinite* reach and extent of his *Providence*, which, with one view, beholds whatsoever is, was, or is to come, yea, or can be: the *unerring certainty of his Decrees*, which tho' they be absolutely unchangeable, yet do not in the least prejudice the liberty of *Man's Will*. And lastly, by making a deep reflection upon our own *great weakness*, and on the other hand, on the *Amplitude of the Universe*, and all *Created Beings*, how at first they proceeded from GOD, and do still so depend on his *Power*, that they cannot subsist a moment without his *Care* and *Providence*. For the due consideration of all these things, will kindle a *desire* in us to be joyned to him in *Will*, make us to *venerate* his *Decrees*, as judging them most necessary and equal, and to wish for nothing more than to obey his *Will*, and for his *Glory* make no difficulty to hazard the loss of all *things*, even of our *Lives*, and in a *word*, to undertake or suffer any thing that may be offered to us.

IV. *Complacency is a help to the Love of Vertue.* *Complacency* is another *Species* of *Love*, whereby the *Soul* is carried out in *desire* towards *Beautiful Objects*, being greatly taken, and charmed with their aspect. For *Beauty* hath something whereby it powerfully recommends it self, so as to allure the *Eyes* of *Spectators*, and force an admittance into their *Hearts*. Hence the *Antients* were pleased to call it *a silent Imposture, and a Dominion which needs neither Arms nor Guards*, such as persuades without *words*, and makes all *men* readily to submit to its Imperious Yoke. This *Passion* prompts us to desire the *Beauty* of *Worldly things*,

things, and wholly to betake our ſelves to the *Love* of *Vertue*, and by trampling upon all *Earthly Enjoyments*, to aſpire after *Cœleſtial Objects*. For if a comly ſhape of the *Body*, if a ſweet and beautiful Aſpect, if the ſparkling luſtre of a brisk and lively *Eye* be of force enough to aſtoniſh, raviſh and ſurprize, what a degree of *Love*, think we, will not *Vertue* be able to enkindle in the *Hearts* of its Contemplators, who, if we will believe SENECA, ſends her *Light*, as a *Harbinger* before her, into the *Hearts* of all *Men*, ſo as that even thoſe who do not follow her, are convinced of her *Beauty*? What can be compared to the *Life* and *Vigor* which *Fortitude* communicates to the *Eyes*, to the *Intention* they derive from *Prudence*? to the *Reverence* wherewith *Modeſty* adorns them? to the *Briskneſs* and *Serenity* which *Joy* affords them? and laſtly to the *Awfulneſs* which *Severity* puts upon them? What can be imagined more *Beautiful* than *Juſtice*, which makes *Princes* moſt like to GOD? What more comly than *Temperance*, which ſets bounds to *Pleaſures*, and never embraceth them for their own ſake? What more ſweet and lovely than *Humanity*, which is affable and courteous to all, and doth ſo far only deſire its own *Good*, as the ſame may be ſerviceable and profitable to others? What more grateful and pleaſing than *Clemency*, which ſpares the *Blood* of another as its own, which by by its kindneſs turns and overcomes the *minds* of the *wicked*, and ſweetly comforts the *afflicted* and *miſerable*? So that by beholding of *Beautiful Objects*, we are inſenſibly led to the *love* of *Vertue*, and taught to deſpiſe and neglect theſe frail and changeable *Beauties*, and to *purſue* the *Eternal Excellence* and Comlineſs of *Vertue* and *Goodneſs*.

V. *Hatred makes us to abhor Vice.*

Neither is the *Paſſion* of *Hatred* altogether uſeleſs, where it meets with *Objects*, on which it may juſtly diſcharge its *fury*. For we *hate* all thoſe things that *hurt* us, or injure our *Soul* or *Body*; and therefore we have good reaſon to abhor our *Vices*, and to avoid all thoſe *things* that diſturb our *Peace* and *Tranquillity*. For if it be natural to the *Soul* to ſeparate it ſelf by *hatred* from the things that are *hurtful* to it, what *Evil* ought ſhe more to deteſt, than that which, in a manner, deſtroys and annihilates it? For the *Soul* dies whilſt it commits *Sin*, and lays violent hands upon it ſelf, as oft as it tranſgreſſeth the *Commands* of GOD, and thwarts the Dictates of its *Conſcience*. Wherefore it is but juſtice to hate our ſelves upon the account of *Sin*, and to be inflam'd with an holy *Anger* againſt our *Defects* and *Tranſgreſſions*, foraſmuch as by means thereof we are turned aſide from our *Chiefeſt Good*, and depart from him, with whom to be united by *Love* is the *Sovereign Bliſs* of *Man*.

VI. *Horrour or Abhorrence makes us to avoid Bad Company.*

The *Horror* we are ſeiz'd with at the beholding of ugly and deformed *Objects*, teacheth us to avoid all manner of *Wickedneſs* and *Pravity*, and to eſchew the company and familiarity of thoſe, who are likely to infect us with their corrupt *manners*. For ſeeing there is nothing in Nature more ugly and deformed than a *wicked and perverſe Man*, we have all the reaſon in the *World* to avoid ſuch a one, as we would do the *Plague*, leſt we ſhould be corrupted by his familiarity, and his *Vices* inſenſibly ſhould get ground of us. *Drunken* Companions eaſily draw in their Aſſociates to the ſame Exceſs; and *Luſtful* and Unclean *Perſons* infect thoſe they converſe with, and *effeminate* the *Minds* of thoſe that keep them company. *Covetous Perſons* inſpire their familiar Friends with a *Stingy Humour*. But what *Body* can be ſo deformed and monſtrous, what *Skin* ſo ſcabby and ulcerous, as to compare with the uglineſs and filthineſs of *Vice*, which changes *Men* into *Beaſts*? This *Paſſion* therefore will be of great good uſe to us, if it prompt us to deteſt the depraved manner of *wicked men*, or whatſoever can defile or weaken our Innocence.

CHAP. XVI.

Of what uſe the Paſſion of Deſire is.

I. *Deſire reacheth after the Things it wants.*

THE End and uſe of *Deſire* is manifeſt from its *Definition*, which declares it to be *a Paſſion, whereby the Soul is carried towards a Good, conſidered as Future*. Which *words* ſufficiently ſhew that this Paſſion aſpires after thoſe things which it wants, and wiſhes the converſation of thoſe which it enjoys. The *Soul* by *Deſire*, is carried to the Poſſeſſion or enjoyment of ſome *Good*, like an *Arrow* driven from a *Bow*, and being raiſed upon the wings thereof, flies to the Mark.

II. *Hope enticeth the Soul to deſire Beatitude.*

Accordingly the *Soul* by *Hope*, which is the firſt Species of *Deſire*, is ſtirred up to deſire *Happineſs*, and to enjoy that *Good*, which alone can ſatiate it. For as *Bodies*, by *motion*, approach nearer to their *Centers*; ſo the *Soul*, through *Hope*, tends to *Happineſs*, and by its earneſt *wiſhes* and *deſires*, haſtens that, which it ſo much longs for. Wherefore it looks upon theſe days, during which it is compelled to *live* here amongſt *Mortals*, as already paſt and gone; and neglecting things preſent, eſteems them as paſt, before ever they are come. And by this means it is neither corrupted by the *Proſperity* of this *World*, nor caſt down by *Adverſity*; applying the whole drift of her intent to this only, that none of theſe *things* may be a hinderance to her in her Progreſs to *Bliſs* and *Felicity*. O Thrice *Happy* and *Bliſsful Hope*! whoſe *Promiſes* are ſo great and glorious, that they make a *Man Happy* and *Bleſſed*, even before he is in full poſſeſſion of it.

III. *Fear teacheth Circumſpection and Cautelouſneſs.*

On the contrary, *Fear* adviſeth us to undertake nothing without *Heedfulneſs* and *Circumſpection*, and to avoid *Raſhneſs* in all our *Actions*. In the firſt place it teacheth us to examin all thoſe things that may any way hinder or ſtop our intent, and to deliberate maturely and at leiſure, about all thoſe *matters* that are liable to change. For *Præcipitancy* is without foreſight, and cannot but frequently have *Repentance* for its Companion. And in the *next* place, that we foreſee things to come, and with great exactneſs and diligence, conſider the *Evils* that may poſſibly happen to us: For foreſeen evils are leſs afflictive, and we bear thoſe things much more eaſily, that have been our conſtant expectation. *Fear* therefore warns us, that ſtanding in our *Watch-Tower*, we ſhould keep a watchful *Eye* upon things to come; and as far as *Human Foreſight* permits, anticipate the *mutability* of *Fortune*, the *endeavours* of our *Enemies*, and the *inſultings* of Men in *Power*. For

Afflictions

Afflictions and *Hardships* are only intollerable to him, whom they seize all on a suddain and at unawares, and whom they strike before they are discern'd.

IV. *The Usefulness of Jealousie.* *Jealousie* will stand us in good stead, when by it we are stirr'd up to endeavour to secure the *Possession* of those things which we count the best and most excellent of all others. This *Passion* moves and actuates the *Philosophers*, when they contend for the *Truth*, which they suppose themselves to have espoused, as for their neareſt and deareſt Interest, and endeavour to vindicate it from all Suspicion of *Errour*, in opposition to all the Attacks and Assaults of their *Adversaries*. Hence it is that Controversies about *Religion* are maintained in the *Minds* of *People*, whilst every one is *jealous*, lest the *Religion* he professeth should suffer any thing by his slackness or indifferency, or that he should be forced to desert it. Thus *Princes* and others, that have an *Honourable Name* in the *World*, are extreamly Jealous of their *Good Name* and *Reputation*, and leave no *Stone* unturn'd to preserve the same in its full Luster and Glory; because they look upon the Opinion which others have of their *Vertue*, to be above all things most conducive to their *Honour* and *Esteem*, as well as the safest and strongest guard, against the Assaults of their *Enemies*. In a word, *Jealousie* may be of use to all, if the *Good*, the loss whereof they apprehend, be of great Concern to them, and such as they cannot be deprived of without great Shame or Loss. For as no Body faintly and carelesly Endeavours the obtaining of *Riches* or *Honour*; so it is no wonder to see *Men* strangely moved and concern'd, whenever they are threatned with the loss of either of them.

V. *Despair is sometimes of use to Lovers.* Altho' *Despair* be the most odious of all *Passions*, and be generally accounted the Common *Enemy* of *Mankind*, yet is it not altogether without its Usefulness. For inasmuch as it considers the desired *Object* as Impossible, and excludes all hope of ever obtaining it, it may be of advantage to *Lovers*, when they find themseves neglected and despised by the beloved *Object*; because then this *Passion* strongly persuades them to give over their vain pursuit, and to cease their frustraneous Endeavours, and to quit themselves of their Ill-advised *Desires*. It tells *Men*, that it is *Madness* to doat upon an ungrateful and insensible *Object*, and to cast away our *Love* upon that which cannot, or will not love us again.

VI. *Despair makes Souldiers Valiant.* As *Despair* proves advantagious to *Lovers*, so likewise it is useful to *Souldiers*, in cases where they are prest with *Difficulties*, and see no way open to escape their *Enemies*: For then it prompts them, since they are necessitated to engage those that are much stronger than themselves; and that in all probability they must *dye*, to sell their *Lives* as dear as they can, and in some kind make amends for their Loss, by causing a greater Loss to their *Enemies*. For *Necessity* often steels *Cowards* with *Valour*; and *Despair* hath often made weak and fearful *Troops* to triumph over *Conquerours*. This *Passion* inspir'd LEONIDAS, when with a small Handful of *Souldiers*, he set upon *Xerxes*, whose *Fleet* the *Sea*, and whose *Army* the *Land* was scarcely able to contain. For having posted himself with 300 *Men* in the Narrow-passage of the *Thermopylæ*, he stood the shock of that prodigious *Power*, and died valiantly with his whole little *Army*.

VII. *Fluctuation, or Doubtfulness of Mind, useful in the Choice of things.* *Fluctuation* of *Mind* is necessary, when we are engaged in the Election of *Good things*; for seeing that one *Good* is preferrable before another, and that all are not of the same Value, we have need of time before we can certainly know, whether the *Judgment* we frame concerning Things, be conformable to them, and consonant to all the *Circumstances* that concur to their *Perfection*. For we cannot, like *Angels*, understand things that are offer'd to us, in an Instant; our *Knowledge* is successive, and as the *Sun* from the Dawning increaseth to the perfect *Day*, so some time is to be allowed to our *Soul*, that after a mature Reflexion of *Judgment*, she may deliberate of things, and consider what she ought to determine concerning them. For seeing that things are various and manifold, and not equal in degrees of *Goodness*, their Nature must be diligently examin'd by us, that we may come to know what is *Good*, what *Better*, and what *Best of all*. For *Men* are very apt to favour their first *Thoughts*, and either from an Affection for *Novelty*, or too great Indulgence and Love for the Off-spring of their own *Brain*, to embrace that which first presents it self to their *Minds*. Wherefore *Delay*, which *Fluctuation* of *Mind* doth suppose, is very necessary to discern *Truth* from *Falshood*, and to make a due distinction betwixt *Good* and *Better*.

VIII. *Courage and Boldness are great Helps to Fortitude.* *Courage* and *Boldness* are good Helps to *Fortitude*, and superadd both Force and a Spur to that most *Generous Vertue*. For *Fortitude*, without the Company of *Boldness*, is but faint and languishing, and stands in need to be excited by its *Heat*, to the attempting and undertaking of *Great* and *Worthy Atchievements*. This *Passion* may lawfully and worthily be employed, in repelling the *Enemies* of our *Country*, and in defending the *Life* and *Honour* of our *Prince*. *Nature* teacheth us to venture the loss of our *Hand*, for the saving of our *Head*; and to expose any part of our *Body*, to save the whole. This is that which *Boldness* performs, and when Necessity requires, does not only meet *Dangers*, but provokes and contemns them.

IX. *Emulation is conducive to Vertue.* *Emulation* spurs us on to imitate the glorious *Actions* of *Famous Men*, by studying and eying the *Examples* of such as do exceed us in *Vertue* and *Learning*. It sets before our *Eyes* their *Atchievments*, as so many *Originals* for us to express, and to take Copy by, suitable to the Requirings both of *Reason* and *Nature*. For there is an inborn Inclination in all *Men*, to become like their *Superiours* and *Betters*. This makes us to be always in the pursuit of those *Vertues* and *Perfections*, which we see shining so illustrious in others, and enflames us with *desire* to imitate the *Manners* and good *Qualities* of those who excel us, especially in *Intellectual Endowments*.

CHAP.

CHAP. XVII.

Of the Usefulness of Joy and Sorrow.

I. *All pursue Pleasure.* IT is not without Reason that some *Physicians* tell us, That the desire of *Pleasure* is Natural to *man*; for it is subservient to the *Mind*, and fills and satiates the wants of the *Body*. *Young men* are inclined to *Pleasure* and Oblectation, because it is serviceable to the ready and vigorous performance of all *Bodily Functions* and *Exercises*, and conduceth to the increase and good state of it. *Melancholy Persons* addict themselves to *Pleasure*, because otherwise the *Humour* that predominates in them would consume their *Body*, and by its malignity make all the *Humours* thereof eager and corrosive. *Old men* delight in *Merriment*; for seeing that the digestive Faculty of their *Stomach* is slow and weak, and that the *Blood* and other *Humours* move but slowly through their *Bodies*, they are with great eagerness push'd forwards to *Pleasure*, as to the only Remedy against all these *Distempers*.

II. *Joy is grateful to the Mind.* What *Pleasure* is to the *Body*, that *Joy* or *Gladness* is to the *Mind*; for it always is a Consequent of its *Tranquillity*, and doth in a manner perfect and compleat all its *Operations*. For even as by a Natural Instinct we are carried to that which is *Good*, and have an Aversion for that which is *Evil*; so we pursue *Joy* and *Pleasure* under the Notion of its being *Good*, and hate *Sorrow*, because it appears to us to be *Evil*. But because *Joy* may be infected by its *Objects*, and be conversant about those things which are unworthy of our *Esteem* or *Regard*, we must examin what is the right use of it, and to what *Matters* it may lawfully be applied.

III. *Joy always doth accompany good Actions.* And indeed *Joy* and *Gladness* are not to be found, but in the Exercise of *Vertue*, and in the pursuit of *Honesty*; seeing that all other *Good things*, which we do so solicitously look after, do not bring forth any true *Joy*, but only some false and feigned *Chearfulness* and *Mirth*, which is always accompanied with *Anxiety* or *Repentance*. For there can be no true *Joy*, but that which springs from the Consciousness of *Vertue* and *Goodness*.

IV. *Derision is useful for the Reproof of Faults.* *Derision*, which consists of *Joy* and *Hatred*, and is occasion'd by the deprehending of some slight or *Venial fault* or *defect*, is frequently of good use for the amendment of *Faults* and lesser *Immoralities*, making him who is derided, to be more watchful over his *Actions*. For finding his *Immoralities*, or undecent *Manners*, to be exposed to *Jest* and *Laughter*, and that they furnish others with Matter of *Raillery* and *Merriment* at his Cost, he resolves to correct the same for the future, and so to prevent the like *Errours*, that he may no more become a *Laughing-stock* to others.

V. *Envy is troubled at the Exaltation of the Wicked and Unworthy.* *Envy*, forasmuch as it is a *Passion* and a Species of *Sorrow*, is not without its usefulness, it being that *Affection* whereby a *man* is displeased at the Prosperity or Elevation of another, because he is unworthy of it. For it seems but reasonable, to be moved with *Envy* and *Indignation* against those, who without their *Merit* are raised to ample *Fortunes* and high *Employs*. For whatsoever is conferr'd upon *Unworthy persons*, is look'd upon as a piece of *Injustice*, when that which should be the Reward of *Vertue*, is made an Encouragement to *Vice* and *Wickedness*. From all which it is apparent, that this Affection is distinct from that *Envy* which is a *Vice*, because this latter hath not for its Object a Person *unworthy* of the *Good* he enjoys, but rather conceives a *Joy* and *Gladness* from the Miseries of the *Good* and *Vertuous*; whereas the former is only offended at the Prosperity of such as are *Unworthy*, but reaps no pleasure at all from the *Misfortunes* of those that are *Good* and *Vertuous*. The *Good things* for which we commonly Envy others, are *Riches*, *Honours*, and other such like, depending on the Gift of *Fortune*: For no Body is Envied for his *Vertue*, nor for his *Nobility*, *Beauty*, or other Endowments or Embellishments, whether of *Body* or *Mind*; forasmuch as they do not depend of his Industry, but were bestowed upon him by *Heaven*, before ever he was capable of committing any *Evil*.

VI. *Compassion relieves such as are in Misery.* *Compassion*, or *Pity*, on the contrary, provokes us to assist and relieve such as are in Misery, and to shew Kindness to those whom we suppose to be Unhappy, without any of their *desert* or *merit*. For it is not a Vice of the *Soul* (as some *Philosophers* have supposed) to pity the *Miseries* of others; but rather a kind of Pious *Sorrow* and Blessed *Misery*: Because this *Affection* doth not only move the *Mind* conformably to anothers *Calamity*, but also strongly excites it, to endeavour the easing and removing of it. For it is a *Duty* we owe to *Nature* and *Humanity*, to condole with those that are Afflicted, and to endeavour to lend a Helping-hand to those that are oppress with *Calamities*, and who without *Speaking*, strongly cry to us for help. It is no *Relief* to a miserable Wretch, that we are touch'd with *Grief* and *Compassion* at the sight of his Affliction, except also we do help and assist him to the utmost of our Power.

VII. *Satisfaction, or Content, produceth Peace of Conscience.* *Satisfaction*, or *Content* and *Acquiescence* in ones self, doth greatly conduce to Security and Peace of *Conscience*, when we call to mind any good *Action* that hath been performed by us. For as, according to HOMERS *Fiction*, the Herb *Nepenthe* added to their Cups, banisht all *Sorrow* and *Sadness* from the *Banquet* of the *Gods*; so a *Good Mind* secur'd and guarded by the Rectitude and Uprightness of its *Conscience*, extirpates all solicitous Anxiety, and begets the highest *Joy* and *Pleasure*. For the *Soul* that is always accompanied by *Innocence*, seems, as it were, to applaud it self, and to be rais'd above this *Earth*, being Conscious to its self of no Crimes, nor distracted by the *Guilt* of *Sin*. Hence it is, that those who are safe and secure by reason of the *Purity* of their *Conscience*, are always of an even Temper, and tho' in the presence of a *Tormentor*, that stands ready to Torture them; of *Fire*, that is ready to consume them; and of a *Funeral Pomp*, to appall and terrifie them, continue unmoveable, fixed on the Rock of a good *Conscience*, being unconcerned at the raging *Waves* and *Winds* that roar about them.

VIII. *Repentance is necessary for the Effacing of Sin.* But *Repentance*, which supposeth *Guilt*, and which torments the *Guilty* with the Checks and Stings of *Conscience*, puts them upon bewailing of what is past, and to get rid of the Burthen that presseth them. For as nothing is more pleasant and joyful, than a *good Conscience*; so nothing is more tormenting than a Bad one: No *Wild Beast*

tears and rends more Cruelly, no *Flame* burns more smartly, or *Torments* the *Body* more excessively, than a *Guilty Conscience* racks and tears the *Soul*, whose Inmate it is. Whosoever *Sins*, hath his *Punishment* immediately attending him, and his Crimes make him sufficiently miserable, without the Ceremony of a *publick Condemnation*. *Punishment* is the individual Companion of *Wickedness*, and never to this *day* was there any *Man* found that sin'd on free cost. *Repentance* therefore makes a *Man* after the *Commission* of *Sin* to hate himself, and from a serious abhorrence of his *Crimes*, to amend what is amiss, and enter upon a new course of *Life*.

IX. *Favour makes us to Love the followers of Vertue.*

Favour, which makes us wish well to those that are *Vertuous* and do *worthy Actions*, is a great incentive to the *Love* of *Vertue*, because it inclines us to *Love* the same in others, and to bear good will to all the followers of it: Whereas on the contrary we do hate *perverse Men*; and tho' we do not abhor their persons, yet we do always abhor their *Vices*. It is inborn, and natural almost to all *Men*, to be angry with, and have indignation against *Evil doers*, and those who tho' they be never so criminal do go unpunished. But yet we are to take heed, that we do not imitate those *Peevish* and *Morose persons*, who are moved at things of little or no moment, and confounding slight fooleries, with the highest *Crimes* do abhor, the one as much as the other. It is the property of a *Morose* temper, to inveigh bitterly against small *Faults*, and to condemn all things that are not suited to his Temper and Apprehension.

X. *Gratitude prompts us to the rendring of Benefits.*

Gratitude, which preserves the pleasing memory of *Benefits* received, incites us to the endeavour of repaying them with like good *Offices*: Which may be done by us 2 manner of ways; the first when by *Gifts*, or otherwise, we acknowledge the *Favour* or *Benefit* we have received. Thus we read, that *AUGUSTUS CÆSAR* rewarded the good Office done to him by a *Veteran Souldier*, in rescuing him from imminent *danger*, at the *Battle* of *Actium*. For when he being accused at *Law*, and in danger of being condemned had desired *AUGUSTUS* to appear for him, *CÆSAR* would not suffer his *Attorny* to plead for him, but himself appeared, and pleaded, that he might not seem ungrateful to him, who had saved his *Life*. The *other* way of shewing our selves *Thankful* is, when we receive a *Benefit* with a grateful *Mind*, and are ready at all times to acknowledge it. For indeed the returning of a *good* deed, does not so much consist in our recompensing it by good *Offices*, as in a grateful temper of *Mind*, whereby we are ready to acknowledge the favour bestowed upon us. For a *Debt* may soon be paid, and what hath been *Stolen* restored; but he properly repays a *Benefit*, who keeps it always in grateful *Memory*, and owns himself under *Obligation* for it.

XI. *Anger is of use to Princes and Magistrates.*

Anger, which the *Stoicks* do so much inveigh against, calling it a *short Fury* or *Madness*, hath also its use, as long as it continues within the Bounds of *Reason*, and does only moderately move and affect the *Soul*; for being thus qualified, it is serviceable to *Kings* and *Judges*, to the removing of *Lenity* and *Fear*, which may oppose themselves to the Strictness and Severity of the *Law*, and incline them to over much *Clemency*. Thus it is lawful for *Judges* to be exasperated against the *Crimes* of *Malefactors*, who violate the *Laws*, and infect others by their wicked *Examples*. It is also serviceable to *Kings* in *Governing* of the *Commonwealth*; for it is necessary for *Kings*, to avenge the *Injuries* and *Indignities* offer'd to themselves, and to be as ready to punish *Traitors*, as to resist and oppose their *Enemies*. For who will say, but that it is a just anger in *Princes*, which engageth them to inflict the worst of *Punishments* upon *Traitors*, who are guilty of the worst of *Crimes*?

XII. *Glory and Shame of what use they are, and to whom.*

Glory and *Shame* are of extraordinary use, and advantage to those who are taken with the desire of *Vertue*; for these 2 *Passions* naturally lead to her, and tho' they go different ways, yet tend to the same end. For *Glory* is as it were a *Spur*, egging us on to great and generous *Actions*, and to the undertaking of the most hazardous Exploits. It was under the conduct and command of this *Affection*, that the *Romans* procured their *Greatness*, and subdued all their *Neighbouring Nations*. It cannot be denied but that the *Love* of their *Country*, was a great and strong motive in the accomplishing of those brave *Actions*, but yet their desire of *Glory*, was a much stronger incentive to them. For indeed *Vertues Vigor* and *Force* seems to languish and expire, when it is not kindled with the desire of *Praise* and *Honour*; and the whole strength and Briskness of the *Soul* is very rarely exerted, but in the midst of *Spectators*, that are ready to applaud and extol it.

XIII. *Shame keeps a man from the Commission of Sin.*

And *Shame* on the other hand deterrs a *Man* from *Vice*, and makes those things odious, which otherwise would appear delightful. This *Passion* may well be called the *Guardian* of *Vertue*, because it makes us to flee from the Face of every shameful and filthy Act. This keeps *Judges* to their *Duty*, and compells them to do *Justice*, for fear of making themselves infamous. This *Passion* furnisheth *Women* with *Arms*, wherewith to defend themselves against the attempts of *Lewd* and *Lustful Men*. And therefore *SYNESIUS* calls *Shamefac'dness* the second *Good* of *Man*, because it keeps them innocent, and doth not only hinder them from committing *Wickedness* in publick, but also in private.

XIV. *Chearfulness assists us in the bearing of Adversity.*

Chearfulness teacheth us to bear *Afflictions* and *Adversity* with a pleasant *Mind*, and to undervalue and despise the *Calamities* we lye under. It informs us that it is *Prudence*, to despise the *Evils* and *Calamities* of this *World*, and to rejoyce in the midst of those troubles, wherewith we are continually tost in this *Life*. For as *Gold* shines bright in the *Fire*, and by all the violence thereof loseth nothing of its weight or *Splendor*, so a *Chearful Mind* is of proof against the *Injuries* of *Fortune*, and turns its *Calamities* and *Afflictions* into *Pleasure*: It considers that nothing is more sweet, than the remembrance of past *Labours* and *Miseries*, and that that prosperity is sweetest, for which we have been prepared by the *Bitterness* of *Suffering*.

CHAP.

CHAP. XVIII.

Of the Government of the Passions, and of their more general Remedies.

I. *The particular Remedies of all the Passions are not to be here expected.*

FOrasmuch as the *Happiness* of *Mans Life*, depends on the right governing of the *Passions*, and that they may be accounted truly happy in this *World*, that have attained to a full *Dominion* over them; we are to consider, how their *Excesses* may be best avoided, and the ill *use* of them prevented. Not that I do intend here to prosecute the particular *Remedies* of all the *Passions*, which *Reason* prescribes for the subduing or moderating of them, because that would be a greater Task than I can here undertake, in this short Discourse of *Ethicks*; but only to set down the more general *Remedies*, to repress their force, and to over come their Excesses.

II. *We are to examine things before that we give way to any Passion about them.*

And here the *First* thing we meet with is, that we cautiously and diligently enquire into the nature of the thing that is presented to us, and that we abstain from passing a Judgment concerning it, as long as we find our selves moved by any *Passion*, so as to be byast thereby to one Object more than towards another. For since all the *Inclinations* that proceed from them, are only the effect of a confused Perception, they cannot offer any thing, that is clear or distinct to our *Mind*: And therefore we must endeavour, if the time permit, to turn our *Thoughts* to some other Matters, for a *Season*, until the Commotion of our *Blood* be over.

III. *Whilst a Passion presseth upon us, the contrary reasons are to be noted.*

I said, *if the time permits*, because when the *Passion* is violent, and the case requires, that without any delay, a present *Resolution* be taken; the *Will* must consider and weigh the *Reasons*, that oppose the said *Passion*, tho' it may be they appear inconsiderable and of small moment to us. For we are to lay this down for a certain truth, That the *Passions* are deceitful, and that their main drift is to impose upon us, and lead us into *Errors*. And tho' it may seem to be a very difficult thing, after that a *Passion* hath made its onset upon us, and put our *Blood* into a Commotion, to put a stop to the Course of the *Animal Spirits* into the *Muscles*, in order to execute the command of our *Passions*; yet is it not a thing impossible, but may be performed, by diverting our *Mind* from the thoughts it is upon, by representing to it the contrary Reasons. Thus when an *Enemy* sets upon us at unawares, such a suddain event affords us no time to deliberate: Wherefore in this case, if we find our selves seized with *Fear*, our business must be to turn our thoughts from the consideration of the danger we are in, by listning to those *Reasons* that tell us, that there is both more Safety and *Honour* in resisting an Adversary, than in giving way to him, or turning our back upon him. And on the contrary, when *Anger* seizeth us, and that we find our selves provoked to *Revenge*, and rashly to rush upon our *Enemy*, we must call to *Mind*, that it is a piece of great *Imprudence* to cast our selves away, when as we may preserve our *Lives* without *Shame* or *Infamy*, and that it is no Shame for a Man to recant, or to submit himself where the match is unequal, rather than to rush on rashly upon apparent *Death*.

It is also very conducive to the governing of our *Passions*, to accustom our selves, whilst we are in a sedate and tranquil temper of *Mind*, to weigh and examin all the *Good* and *Evil things*, that any way may happen throughout our whole course of *Life*, and to discuss their nature and value, that afterwards upon occasion, we may be able with more readiness to form true *Judgments* concerning them, and certainly and without any hesitation discern, what ought to be avoided, and what to be embraced by us, whatsoever any rising *Passion* or Supervening reasons, may insinuate or suggest to the contrary. For if we direct and govern all the *Actions* of our *Life*, according to some certain and premeditated *Judgments*, it will not be difficult for us to repress the Violence of our *Boyling Passions*, and to break the force of them. For how weak soever we may be, and how easy soever to be overcome by our *Passions*; yet if we do but apply our selves to such thoughts as these, and often revolve them in our *Minds*, we shall at last come off *Conquerors*, and attain to an absolute Dominion over our *Passions*.

IV. *We must examin the nature of things whilst we are Tranquil and Sedate.*

It will be of great use also towards the taming of our *Passions*, to curb our *Desires*, and not suffer them to Rove beyond the requiring of *Nature*. For tho' *Desire* be a peculiar *Passion*, yet it mingles some way or other with them all, so that he who can tame its unrulines, will easily cure the *Distempers* of all the rest. For all the motions of *Desire* as they are Solitary, and by themselves, are dark and languishing, except they receive light from abroad, and chiefly from the Goodness and Excellence of the Object, about which they are conversant. And forasmuch as some of the things that are desired by us, do altogether depend upon our selves, and some upon others, and some also partly upon our selves, and partly upon others, we ought very narrowly to examine, how we ought to carry our selves with relation to these several *things*, and what curbs are best to be made use of to restrain the great variety of our *desire*.

V. *He that can overcome desire will soon get the Dominion over all the rest of his Passions.*

As to those things which are in our Power, these may lawfully be desired by us, as long as our desires of them are well grounded, and proceed from Good and Vertuous motives; for seeing that they proceed from a perception of *Good*, and only tend to our Complement and *Perfection*, to endeavour the satisfaction of them, is to act conformably to *Nature*, and to follow the Dictates of *Vertue*. But who dares say, that any one can with too great eagerness pursue *Vertue*?

VI. *How far we may desire the things that are in our Powers.*

But as to things that are forein to us, and in the *Power*, and at the disposal of others, our *desires* towards them can never be faint and weak enough: Yea we must strive, as far as lies in us, altogether to abstain from the prosecution of them, having our *Mind* fix'd on the Contemplation of the *Great GOD*, by whose *Providence* all things are governed and dispensed, and whose Boundless *Goodness*, Infinite *Wisdom*, and Infallible *Decrees* are only worthy of our continual *Thoughts* and *Attention*. Wherefore we must consider, that all whatsoever happens to us is *necessary*, excepting only those things, which it hath pleased *GOD*, should alone depend upon our *Wills*, and which by his Decree he hath ordain'd, should by such and such ways be conveighed to us.

VII. *We must not desire any thing that is in the Power of another.*

And

And being thus perſuaded, as we ſhall not deſire the *Goods* of *Fortune*, ſo neither ſhall we fear its *Evils*, foraſmuch as they are only ſuch, by reaſon of our Opinion of them, and the *Error* of our *Underſtanding*; but ſhall rather willingly ſubmit to them, as being deſigned for us by his unerring *Providence*, and infallible in their Contingency. And accordingly giving way to *Time* and *Chance*, we ſhall undauntedly expect whatſoever may happen to us, as being undoubtedly aſſured, that they cannot deprive us of the leaſt part of any true *Good* we are in poſſeſſion of; yea, moreover that they are very conducive to our *Beatitude*, if we know how to make uſe of them as we ought, and as becomes a *Philoſopher*.

VIII. *We are to moderate our deſires about thoſe things which partly depend on us, and partly on others.*

And as to thoſe things which partly are in our *Power*, and partly at the diſpoſe of others, ſuch as *Health*, *the Government of our Families and Adminiſtration of State Affairs*, we muſt take care that we do not too eagerly deſire the ſame, or be too earneſtly carried out towards them, when they ſeem to be in our *reach*; but that we remember always ſo to curb our *deſires*, that we only extend them to thoſe things that are in our *Power*, and depend on our *Free-will*: So that if our endeavours chance to ſucceed, we ſhall obtain the thing we *deſire*; but if not, at leaſt we ſhall have the comfort that we have performed our Duty, and done what was in our *Power*; and therefore ſhall look upon them as *Impoſſible*, and ſince the obtaining of them is not in our *Power*, we ſhall ſuppoſe them not at all to belong to us.

IX. *Generoſity is a great Remedy of the Paſſions*

Generoſity may be conſidered as another general *Remedy* of our *Paſſions*, which being as it were the *Key* to all *Vertue*, ſo it is a powerful means to ſubdue and moderate our *Affections*. Now *Generoſity* conſiſts in this, that a *Man* do value and eſteem himſelf to the utmoſt of his worth; for having this reſpect and conſideration for himſelf, it will engage him not to omit any thing he ought to do, as well as from undertaking any thing unworthy the excellence and *Dignity* of his *Nature*. For conſidering that nothing properly belongs to him, beſides the free diſpoſal of his *Will* and *Choice*; and that nothing is praiſe-worthy or commendable in this *Life*, ſave only the due uſe thereof, he will ſuppoſe himſelf to have attained the higheſt ſtep of Felicity, if he find in himſelf a fixt and conſtant Reſolution and purpoſe to make good uſe of them; that is never to want a *Will*, to undertake or execute all thoſe *things*, which he judgeth to be beſt, which in a ſtrict and proper Senſe is to *follow Vertue*. For tho' he hath this due eſteem of himſelf, he does not therefore deſpiſe others, but rather perſuades himſelf, that all other *Men* have the ſame *Thoughts* of themſelves: And therefore he never undervalues other *Men*, and if by chance he diſcover any defects or *weakneſs* in them, he is more ready to excuſe than carp at them, and to perſuade himſelf, that they commit thoſe Failings, not for want of a good *Will*, but for lack of knowledge, and due Information.

X. *The higheſt remedy againſt our Paſſions is the Love of* GOD.

But the moſt powerful *Antidote* againſt our *Affections*, is *the Love of* GOD, which natural *knowledge* implants in our *Souls*. For this being the moſt pleaſant and delightful of all the *Paſſions*, we can be affected with in this *Life*, and the moſt ſtrong and prevalent alſo, it muſt conſequently have the *Power* of ridding us from the Dominion of all other *Paſſions*, and not only of curing all the *Vices* of the *Mind*, but alſo of removing all the bitterneſs of *Bodily Sickneſs*, and of ſweetning all the *Troubles* and *Affictions* of this *Life*, which are the inſeparable Companions of all *States* and Conditions whatſoever. And how this *Divine Love* may be obtained by us, *DES CARTES* informs us in the 35 *Epiſtle of his firſt Volume*, to which I refer the *Reader*.

CHAP. XIX.

Of the Liberty of Mans Will.

I. *How thoſe who deny the free-will of Man may be convinced.*

AFter having ſpoken of the *Vertues*, and ſhewed the uſe of the *Paſſions* we might ſeem to have performed little or nothing towards a *Bleſſed Life*, if we ſhould not now proceed to demonſtrate, that *Man* is endued with a *Free-will*, and that it is in his *Power* to exerciſe *Vertue*, and make good uſe of his *Affections*. For there be ſome, that are ſo ignorant of themſelves, and ſuch negligent ſearchers into the ſource of their own *Actions*, that they attribute all things to a Blind *Neceſſity* or *Fatality*, and ſuppoſe *Men* to act from an impreſt inſtinct, and that nothing is done by them which is not neceſſarily determined. But theſe *Men* do very well deſerve to be tied to a *Stake*, and there laſht ſo long, till they beg thoſe that beat them to ſtop their *Hands*, and confeſs that it is in their *Power*, to ceaſe from beating of them, when they pleaſe.

II. *Human Actions ſhew that there is a Liberty of acting*

For what is more contrary to daily experience than to believe, that it is not in our *Power* to *Speak* or *hold our Peace*, to *ſtand ſtill*, or to *walk*, to reach forth our hand to a poor *Beggar*, or to paſs him by unregarded? This is ſo notoriouſly manifeſt, that as St. *AUSTIN* ſaith, it is *Sung by Shepherds* on the *Mountains*; by *Poets* on *Theaters*, by *Balladmongers* in their *Rings*, by the *Maſters* in *Schools*, and by all *Mankind* in the *World*. For if *Men* have no Free-will, to what purpoſe are *Laws* made? Why are *Rewards* promiſed to thoſe that are *Good*, and *Puniſhments* threatned to the *Bad*, if the things for which they are rewarded or puniſhed, were never in their *Power*, and that they *ſinned* againſt their *Will*, or by the force of neceſſity performed ſome good ſervice to their *Country?* Why are *Exhortations* uſed? Or why do we endeavour to excite men to *Vertue*, if we have no *Strength* of our own ſo to obtain it? And if like *Children* and *Madmen*, we want the power of chuſing or refuſing?

III. *He that takes away mans Liberty of Will takes away Sin.*

Moreover, if we do all things by a kind of fatal neceſſity, what will become of Prevarication and *Sin?* Or where ſhall we find any *Tranſgreſſion* of the *Law*, if uncontrolable force be the ſource of our *Actions*, and if they be the reſult of *Nature*, and not of our *Will? Neceſſity*, ſay the *Lawyers*, *makes void an Action, and he that Governs, muſt not be in the Power of any one.* It is evident therefore that *Men* are free, and ſo far at their own diſpoſe, that when *Good* and *Evil* are ſet before them, they may chooſe that which is *Good*, if it be repreſented to them under that Notion; or *Evil*, yet always under the appearance of ſomething that is *Good*, if the ſaid appearance do more ſtrike their *Underſtanding* and attract their *Will*: Or when two good things are propounded

pounded together, they can chuſe the one and leave the other, if it appear more ſuitable to them, and more excellent and worthy in it ſelf.

IV. *If there be no Liberty of the Will, all Deliberation is in vain.*

But what need is there of ſo many *words* to make out a thing that is ſo Notorious and obvious almoſt in all *Human Actions*? There is nothing more common amongſt *men*, than to deliberate and take *Counſel* in doubtful Affairs; not only the *Common People*, but even *Kings* themſelves have recourſe to this Expedient. For ſeeing that every one is more dull-ſighted in his own buſineſs and concerns, than in thoſe of another, *Princes* muſt make uſe of *Counſellors*, that may be unto them inſtead of *Hands* and *Eyes*, and may help them in all things. But pray, to what purpoſe are theſe *Counſellors*, if it be not in the Power of the *King* to take their Advice, or to change his Purpoſe? *Nature* hath made us *Teachable Creatures*, and beſtowed upon us an Imperfect kind of *Reaſon*, which can be amended and perfected by good Inſtitutions. And accordingly there is nothing that more ſtrongly induceth *men* to love *Vertue*, and recalls *wicked Men* to that which is Right, than the *Converſation* of *good Men*, by whoſe Example *Vertue* is recommended and learn'd, and by degrees takes root in the *Heart*. But alas! how uſeleſs would it prove to Converſe with *good Men*, if it be not in our Power to imitate their *Actions*; and if for want of this *Free-will*, we cannot follow that which is Beſt? We muſt therefore be poſſeſt of a *Free-will* before any of theſe things can be advantagious to us; and as it is in our Power to recall our *Eyes* or *Mind* from any *Object*, ſo it is likewiſe in our Freedom to withdraw our *Affections*; except we will confeſs, that *Knowledge* was given us to no purpoſe at all, and that it is of no uſe to the governing or directing of our *Actions*.

V. *He that takes away the Freedom of Man's Will, baniſheth Vertue out of the World.*

Human Society cannot ſubſiſt without *Vertue*, which being taken away, the Beautiful *Order* of the *VVorld* muſt be overthrown, *Government* muſt degenerate into *Tyranny*, and all the Concerns of *Mankind* be expos'd to the tumultuous Motions of the *Paſſions*. Wherefore it is neceſſary, that *Vertue* be ſeated like a *Judge* over all, and to render to every one his due; to *GOD*, by *Religion*; to our *Country* and *Parents*, by *Love* and *Obedience*; to our *Fellow Citizens*, by various Offices of *Juſtice* and *Charity*. But take away the Liberty of our *Actions*, and all theſe things vaniſh, and there remains nothing in the *VVorld*, but confuſion and corruption of *Manners*. For how ſhall *Temperance* be able to contain her ſelf, and ſuppreſs all inordinate *Deſires*? What ſhall put *Fortitude* upon difficult and dangerous Exploits? By what means ſhall *Juſtice* pay what is due to another, and obſerve the *Rules* of *Equity*? If ſo be it is not in their power to abſtain from *Pleaſures* and *Luſts*, to avoid things difficult and dangerous, or to keep what is *anothers* by force. We muſt therefore of neceſſity conclude, that the *Power* of *Free-will* hath been vouchſafed to *man* by *GOD*, and that in all his *Actions* he is not driven by Neceſſity, but led on by his own *VVill*. For otherwiſe, why might not all the *Failures* and *Sins* of *Nature* and *Men*, be imputed to *GOD*, if he be the only *Agent* in the *VVorld*? Or, why might not he be ſaid to commit all *Evils* and *Crimes* that abound therein? It was therefore neceſſary, that *Man* ſhould be endued with *Liberty*, to the end that his own *Actions* might be recompenſed unto him, and he receive the *Reward* or *Puniſhment* due to his *VVorks*.

VI. *The Free-will of Man depends upon GOD.*

But tho' every one doth experience this power of *chooſing* in himſelf, and find that his Will in its determinations, doth not depend upon any *created Agent*; yet neither muſt it be conceived to be utterly independent; for tho' *Free Will*, as DES-CARTES ſaith, if we give heed only to our ſelves, cannot but be conceived as *Independent*; yet if we conſider the infinite *Power* of *GOD*, we muſt of neceſſity believe, that all things depend on him, and that conſequently our *Free Will* cannot be exempt from his Dominion. For it implies a contradiction to ſay, that *GOD* hath created *Men* of ſuch a *Nature*, that the *actions* of their *Wills* are independent of his *Will*; becauſe this is the ſame, as if we ſhould ſay, that his *Power* is both finite and infinite. *Finite*, becauſe there is ſomething that does not depend on his *Will*; and *Infinite*, in that he could make that thing independent.

VII. *The Liberty of our Will, doth not make the Exiſtence of GOD, doubtful.*

But as the *Knowledge* of the *Divine Exiſtence* muſt not take away the certainty of our *Free Will*, ſo muſt neither the *Knowledge* of our *Free Will*, make the *Exiſtence* of *GOD* doubtful to us. For the *Independence* which we experience, and are ſenſible of in our ſelves, and which is ſufficient to make our *Actions* worthy of *Praiſe* or *Reproach*, is not repugnant to a dependence of another kind, according to which all things are ſubject to *GOD*.

VIII. *An Objection anſwer'd.*

If any one ſhould object here that *Paſſage* of the *Romans*, *The Good that I will, I do not; but the Evil I will, that I do*; and ſhould from thence infer, that he who does not what he *Wills*, and does what he *Wills* not, cannot be ſaid to be free. I Anſwer, that this ſaying of the *Apoſtle* is to be underſtood of the firſt motions of *Concupiſcence*, which are not in our *Power*, neither are imputed to us as *Sin*; and therefore the *Apoſtle* ſubjoins, *Now if I do that which I would not, it is no more I that do it, but Sin that dwelleth in me*; which, ſince it took its birth from the firſt *Sin* of *Man*, and that it is the Cauſe, and as it were, the Mother of all the *Sins* we fall into, is therefore by the *Apoſtle* called *Sin*. Wherefore alſo the *Apoſtle* afterwards adds; *O wretched man that I am, who ſhall deliver me from the Body of this Death*, that is, from the hard Yoke of *Concupiſcence*; and preſently after anſwers his own *Queſtion*, *the Grace of God through Jeſus Chriſt*.

CHAP. XX.

How, preſuppoſing Gods Omnipotence, Men can abide Free in their Wills; and whether the Free Will of Man can be hindered.

I. *An Objection againſt the foregoing Chapter.*

FROM what hath been ſaid in the foregoing *Chapter*, no ſmall difficulty ſeems to ariſe, which muſt not be omitted by us. If it be true, will ſome ſay, that all things are ſubject to the *Divine Power*, and conſequently, that all the *works* of our *Will* do depend on him, how then ſhall we be able to ſecure *Human Liberty*, when all things

that proceed from us are ordained by him, and cannot happen without his *Præscience*.

II. *God is said to be a total Cause two several ways.*

We shall resolve this Difficulty by saying, that GOD indeed is the *Total* and *Universal Cause* of all things, so that nothing can be done by any of his *Creatures* that doth not depend on him: yet is not this Causality of his exerted in all after one and the same manner. For in the Production of those things, to which neither our *Free Will*, nor that of any other *Created Agent* doth concur, we must say that GOD only had regard to his own *VVill*, according to which he absolutely determined to produce them after such a certain manner, and such a determinate time. But as to those things which the *VVill* of *Man* hath some power over, he did not singly regard his own *VVill*; but had regard also in his *Decree* to the consent of our *VVill*; and would have nothing absolutely to come to pass, without the presupposing of our Determination. For it doth not follow, that because the certain order of all *Causes* is manifest to GOD, that therefore nothing is left in the power of our *Free VVill*, seeing that he himself could not be ignorant of our *VVillings*; which he foreknew were the *Principles* of our *Actions*.

III. *How God acts in Concurrence with our Liberty.*

DESCARTES illustrates this by the Example of a *King* in an *Epistle* of his to *Elizabeth*, the *Princess Palatine*. Suppose we a *King* to have forbidden all *Duels*, and that he certainly knew that 2 of his *Nobles*, the inhabitants of 2 different Cities, had a quarrel together, and to be so incenst against each other, that in case they should chance to meet, they would certainly *fight* one another; if I say this *King* should command *one* of them to take a *Journey* towards that *City*, where the other dwells; and at the same time give the *other* a command to go towards that place where the *former* is supposed to inhabit, he certainly knows that they cannot but meet one another, and consequently *fight* and break his *Command* or *Proclamation*; but yet for all this he doth not force them to it; neither doth his *Knowledge*, no nor his *VVill* neither of thus determining them to this *Action*, any way hinder them from *fighting* as freely, as they would have fought, if he had known nothing of all these particulars, or if by any other occasion they had chanc'd to meet with one another; and therefore he may with as much *justice* punish them for violating his *Edict*.

IV. *God's knowledge and will do not destroy mans Liberty.*

Now what is lawful for a *King* to do, with respect to some of the *Free Actions* of his *Subjects*, the same GOD, whose *Knowledge* and *Power* is infinite, doth, with regard to all the *actions* of *men*. For before ever he sent us into this *VVorld*, he exactly knew how all the Propensions of our *VVills* would be, because he himself put them into us; and also disposed all things without us in such a manner, that these and the other *Objects*, should present themselves to our *Senses*, this or that time, by occasion whereof he knew that our *Free VVill* would determin us to this or the other thing. And this he would have to be so; but yet he would not force us to this. And as in the foresaid *King*, 2 different degrees of Will may be determined; the one whereby he would that these 2 *Nobles* should *fight* together, in as much as he was the cause of their meeting together; and another whereby he would it not, or was against it, in that he had forbid *Duelling* by his *Proclamation*: in like manner our *Divines* distinguish 2 *VVills* in GOD, the one *Absolute* and *Independent*, whereby he will have all things to come to pass as they do; the other *Relative*, which respects *mans merit*, or *Guilt*, by which he will have his *Laws* obeyed.

V. *There be 3 things that hinder the use our Free Will.*

Three things are commonly reckoned up by *Heathen Philosophers*, which may hinder the use of our *Free VVill*, viz. *Fear*, *Ignorance* and *Force*. *Fear* seems to be an Impediment or Bar to *Liberty*, when it is *not the fear of a vain man*, as the *Lawyers speak, but such as is grounded, and may light upon a constant and well resolved person*, because it makes him do those things which he would never do, if he were left to himself, and were not shaken with fear.

VI. *Mans Liberty may consist with Fear.*

But I do not at all approve of this *Opinion*, forasmuch as *Fear*, wherher it be great or small, doth not so oppose Liberty as that it should wholly destroy it: Yea, if we heedfully mind the matter, we shall find that it is always in conjunction with a kind of *VVillingness*, whereby it willingly performs that which *Fear* seems to extort from it. For 2 things are considered in *Free VVill*; *First*, That we do it spontaneously, or of our selves: And *Secondly*, That we do it freely. The former of these *Modes* of *Acting* seems in some sort to be hindred by *Fear*; because we do that, which we would not, if we were not forced to it by the *Fear* of some impending *Evil*. But the latter is not at all hindred by it, because the nature of *Free VVill* doth not consist in *Indifferency*, seeing that we do nothing so voluntarily and freely, as we do those things to which we are determined by an urgent *Cause*. As we see it happens to us when we are egg'd on by *Fear*; for though the Object then be displeasing to us, and that we would rather, if we might, choose the contrary; yet because of the impending *Evil* or *Punishment* we do greedily embrace it, and choose a lesser *Evil* before a greater. And therefore *Lawyers* are of opinion, that all Contracts are not made void by *Fear*, except they be accompanied with *Injustice* as appears *Instit. de* Except. *in Initio. Ex L. Mulier*, §. *finali quod metus causa. Ex L. ultima C. de iis quæ vi*, and innumerable other places.

VII. *Of the twofold Ignorance Vincible and Invincible.*

As concerning *Ignorance*, we shall the better be able to determine, how it may be said to hinder the use of our *Free VVill*, by supposing a twofold *Ignorance*, Vincible and Invincible. *Vincible Ignorance* is that, which by the use of *moral and due Diligence* may easily be overcome. Now a *due Diligence* is that which ariseth from *Vertue*, or the *Love* of *Reason*, and not from any other ground or motive. As by Example, a *Merchant* having an usual *Contract* or *Bargain* offer'd him, doth not examin it, only seeing that he is like to gain by it, embraceth it, without any more ado, or concerning himself any further about it: and forasmuch as he hath not examined it, he doth not know it to be unjust. Now this *Ignorance* of the *Merchant* in Vincible, and doth not consist with *Vertue*; for if he had *loved Reason* above all *things*, he would have diligently examined the said *Contract*, and having found it to be offensive to *Reason*, he ought never to have consented to it, how gainful soever it might appear to be otherwise. But *Invincible* Ignorance is when a *man* cannot know that he is ignorant of, in the circumstances

ſtances wherein he is for that time. As for Example, ſuppoſe we that SEJUS hath writ to his Friend CAJUS to aſſiſt him in ſuch a *Buſineſs*, and that the Letter chance to miſcarry, and never come to his *Hands*; in this caſe CAJUS will be under an Invincible Ignorance, tho' he hath uſed no diligence to the removing of it.

VIII. *How or in what caſe Ignorance doth excuſe a Tranſgreſſor.*

Ignorance, with reſpect to a *Free Act* is found to be threefold. 1. *Antecedent*, which is before any conſent of the *VVill*, and this without doubt is *invincible*, neither can any blame be imputed to it: As if a *man* that is a *Hunting* ſhould kill a *Man*, taking him to be a *Beaſt*; becauſe 'tis ſuppoſed that he never intended any ſuch thing. The *other* is *Concomitant*, which exiſts together with the *Act*, and doth accompany it, inſomuch that it is the *Principle* of that *Action*; and the *Action* would have follow'd, tho' the ſaid Concomitant *Ignorance* had not been: As if a *man* ſuppoſing himſelf to kill a *Beaſt*, ſhould ignorantly kill his *Rival*, whom he hates from his Heart; and whom, if that Ignorance had not been, he would have kill'd notwithſtanding. The *Third* ſort of *Ignorance*, is *Conſequent*; ſo called, becauſe it follows the Conſent of the *Will*, and therefore Voluntary, and therfore is ſomewhat of the ſame Nature as *Invincible Ignorance*: As when a *man* forbears going to *Church*, becauſe by Neglect he never minds or enquires about the Time when he is to go. From theſe things thus briefly ſtated, it is apparent, that it is only *Invincible Antecedent Ignorance* that can make an *Action* Involuntary, ſince whatſoever follows from it was altogether unknown. For nothing is *deſir'd* of *Man*, which is not firſt *known* by him: For the *Underſtanding* is like a *Servant*, that carries a *Torch* before his *Miſtreſs*, the *Will*.

IX. *Ignorance of the Law of Nature cannot be Invincible.*

But here we are to obſerve, that there can be no *Invincible Ignorance* of the *Law of Nature*, which by Natural Inſtinct is known to all; and therefore whoſoever he be that tranſgreſſeth the ſame, can never be blameleſs. Whence is that Common Saying of the *Philoſophers*, *Ignorance of the Law excuſeth no man:* But that the *Ignorance* of *Poſitive Law*, whether *Human*, *Eccleſiaſtical*, or *Divine*, may render an *Action* Involuntary.

X. *The Elicit Acts of the Will cannot be forced.*

It remains next to be explained, whether there can be any Force or Violence that is capable of making the *Actions* of our *Will* Involuntary. To the better ſolving whereof, we are to ſuppoſe that *Human Actions* are twofold, *Elicit* and *Imperate*: Thoſe are called *Elicit Actions*, which are immediately produced by the *Mind*, as from their *Principle*; ſuch as are the Acts of *Nilling* and *Willing*. Others are *Imperate*, which proceed from another *Faculty* than the *Will*, tho' not without the Command of the *Will*, as *ſenſible Perceptions*, the *motions* of the outward *Members*. As to the *firſt* of theſe, it is evident that the *Will* cannot ſuffer any Violence, or that the *Elicit Acts* of the *Will* ſhould be forced; for ſeeing that they proceed from the *Will*, as from their *Active Cauſe*, they cannot be ſubject to any Violence that *proceeds from an Outward Principle*, as ARISTOTLE ſaith, *which can add no Force to the Action*, ſince it is evident that the *Will* is an *Active Principle*, and adds or contributes to its own Acts.

But as for the *Imperate Acts* of the *VVill*, they may be ſaid to be Involuntary; for tho' they depend on the Command of the *VVill*, and follow its Inclination, yet the *Faculties*, eſpecially the outward *Members*, may be ſo hindred by the Force of an *External Agent*, that they cannot execute the Command of the *VVill*; and accordingly we frequently find ſome *motions* produc'd in our *Bodies*, contrary to our *VVills*.

XI. *But Imperate Acts may.*

CHAP. XXI.

Of Human Acts, and of the Goodneſs and Pravity of them.

I. *What an Human Action properly is, and what Principles concur to it.*

BY the Name of *Human Act*, every Action is not be underſtood that proceeds from *Man*, but that alone which is the effect of a *Free Principle* of *Acting*, or which is cauſed by the *Underſtanding* and *VVill*. So that that is only to be accounted as an *Human Action*, whereof a *Man* is the Abſolute *Lord* or *Diſpoſer*, or which he hath in his free Power.

II. *Two things are requir'd to a Human Action.*

There be 2 *Principles* that concur to every *Human Action*, viz. *Underſtanding* and *VVill*. The *Underſtanding* that ſhews the Way, and, as it were, carries a Light before his *Miſtreſs*. For tho' the *Will* be an *Elective Faculty*, by which the *Mind* freely determines it ſelf to doing, or not doing; yet it is firſt required, that the *Underſtanding* do before repreſent or propoſe the thing to her. For as nothing in general can be willed, except it be known; ſo nothing can be freely Will'd, except it be fore-known by the *Underſtanding*. Wherefore every *Errour* that befalls our *Actions*, is chiefly cauſed from the wrong Perception of the *Intellect:* For if ſhe never did exhibit ought to the *Mind*, but what was clear and evident, neither would the *VVill* ever miſtake in her Choice.

III. *Of the Twofold Goodneſs that is found in Human Actions.*

In every *Human Action* a twofold *Goodneſs* may be obſerved; the one *Natural*, which ſome call *Entitative*, which is in all things, inaſmuch as they are partakers of *Nature* and *Entity*. The other *Moral*, which is nothing elſe but the Conformity of a *Human Action*, with *Right Reaſon*. As on the contrary, the *Moral Evil* or Pravity of an *Action*, is its deformity or ſwerving from *Right Reaſon*, that is, when it wants any Perfection, which according to Right Reaſon it ought to have. By Right Reaſon, I underſtand here *a true Judgment of every thing, free from the Paint or Fucus of any Opinions*, whereby the *Laws* of GOD and *Nature* are underſtood, and every thing rightly and prudently diſcerned, according to the Preſcript of the *Law*. Whence it appears, that many *Actions* which agree with regard to *Nature*, do extreamly differ with reſpect to *Manners*. As for Example, *To kill a man*, when it is done of a Mans own Will and Authority, is not diſtinguiſhable from that *Action*, whereby a *man* is put to *Death* by *Publick Authority*; but they vaſtly differ in a *Moral* reſpect, ſeeing it is lawful to *Kill* a *man* by *Publick Authority*, becauſe of the *Juſtice* which is exerciſed in that act, whereby it comes under the Notion of *Good*; whereas to *Kill* a *man* by the impulſe and inſtigation of ones own *Will*, is unjuſt and prohibited by the *Law* of GOD.

An

IV. *What makes any Action Morally Good.*

An *Action* therefore is accounted Morally *Good*, if it reſpect or have an Eye to *Good*, deſired according to *Right Reaſon*. For *Human Actions* derive their Goodneſs from their *Object*, when it is ſuppoſed to be ſuch as *Right Reaſon* preſcribes and allows of: Foraſmuch as an Action is not accounted *Good*, becauſe the *Underſtanding* knows it, and the *Will* rightly deſires it; but rather becauſe the Object of it is *good* and *honeſt*, therefore the *Will* that is carried towards it is *Right*. Wherefore *Right Manners* do not make the Object *Good* and *Honeſt*; but on the contrary, a *Good* Object and agreeable to Reaſon, makes *good Manners*, and conſequently *Human Actions* derive the formality of their *Goodneſs* or *Pravity* from it. And the ſame is to be ſaid of *Evil Actions*, which owe their *Evil* to a ſhameful and diſhoneſt Object; and accordingly the more ſhameful the Object, the more wicked is the *Action*. And foraſmuch as all *Objects* are not Equal, but ſome excel others in *Pravity*, ſo neither can it be ſaid that all Sins are Equal, it being certain that ſome far exceed others in *Evil*.

V. *The Goodneſs or Pravity of Actions depends on certain Circumſtances.*

Neither doth the *Good* or *Evil* of *Human Actions*, ſolely depend upon the *Object*, but alſo on certain *Circumſtances*; which are ſo called, becauſe they always accompany, and as it were, guard and encompaſs our *Actions*, eſpecially thoſe that are outward, and are, as it were, ſo many Accidents obſervable in them. Of theſe there are commonly reckon'd up *Seven*, which are contained in theſe Verſes.

Who, what, where, by what means; why, how and when,
Theſe make or Good or Bad all Acts of Men.

VI. *Who.*

Who, denotes the Perſon and Quality of the *Agent*; as whether, he who hath committed a Rape be a *King* or a *Subject*, a *Citizen* or a *Stranger*, a *ſingle* or a *married Man*.

VII. *What.*

What, intimates the Quality of the Object, about which the *Action* is converſant, whether the party on whom the *Rape* hath been committed, be a *Virgin* dedicated to GOD, or one at her own diſpoſe.

VIII. *Where.*

Where, ſhews the place where the Wickedneſs hath been committed, whether in the *Church* or in a *Profane place*.

IX. *By what means.*

By what means, points us to the Inſtruments or Companions a Man hath made uſe of in the committing of this Wickedneſs. As, whether he ſtruck with a *Sword*, or with a *Stick*; whether he had any to aſſiſt him, and whether they were *Clergy-men* or *Laicks*.

X. *Why.*

Why, makes out the Intention of the *Agent*; as whether a *Man* ſet upon another meerly for gain, or to revenge an Injury.

XI. *How.*

How, holds forth the manner of the Action; as whether a *Man* did hurt or wound another, being provoked by *Wrath*, or in his *right Wits*; whether he aſſaulted him baſely and treacherouſly or fairly and openly.

XII. *When.*

When, conſiders the Time when the *Action* was done, whether in the *Night* or in the *Day* time.

XIII. *Circumſtances do often change the very kind of the Action.*

Which *Circumſtances* are therefore ſaid to concur to *Human Actions*, foraſmuch as ſome of them do very ſignally increaſe the *goodneſs* or *pravity* of them, yea, and ſometimes quite change the kind of them. As for Example, when that which is *ſtolen* is ſomething dedicated to GOD, or his Worſhip; this is not ſimply *Theft*, but *Sacriledge*, which differs in kind from *Theft*, as being ſuppos'd forbid by a Special Precept. And in ſuch a caſe as this they loſe the Nature of *Circumſtances*, and take upon them the Nature of an *Object*, whence, as we ſaid before, *Human Actions* derive their Pravity, and becomes worthy of *Puniſhment*.

XIV. *Of the Duties and Offices, as well of Man in common, as of a good Chriſtian in particular.*

Tho' the *Duties* of a *Man* and *Citizen* might ſeem to require a particular Place wherein to be treated of and ſo to conſtitute the *Eleventh Part* of this *Inſtitution*; yet foraſmuch as they belong to *Human Actions*, and preſuppoſe *Free-will*, I have thought fit to ſubjoyn them here; and keeping my ſelf within the Number of theſe *Ten Parts*, to Treat of them by way of *Concluſion*. For this *Work* might well ſeem to be deficient, if after having explained the Nature of *Vertue*, (which according to the common Diviſion we have diſtinguiſh'd into 4 *Heads*) and having enenquir'd into the Nature of *Human Actions*, we ſhould omit the *Offices* and *Duties* of *Men*, and not amply and diſtinctly Treat of theſe, which are the Conſequents of his *Liberty*. Wherefore we ſhall now ſet down, what are the *Duties* of *Man* in General, and afterwards proceed to the *Offices* of a *Good Citizen*, and ſhow what either of them ought to embrace as *Good* and *Vertuous*, and to reject as *Shameful* and *Wicked*, according to the *Preſcript* of *Nature*; which I ſhall endeavour to perform with all the Brevity poſſible, and as far as the Bounds of this *Inſtitution* will permit.

CHAP. XXII.

Of the Rule of Human Actions.

I. *What things are to be foreknown in this matter.*

SInce to the end a *Man* may act aright, it is neceſſary that he be Conſcious of his *Actions*, or, which is the ſame, that he aſſent to his own *Reaſon* in the Chuſing or Avoiding what is propounded to him; it will be of uſe to us to know what *Conſcience* is, and by what Denominations it goes: As likewiſe what *Obligation* is, to whom it agrees; and how it comes to paſs, that *Mankind* is bound to obſerve ſome *Inſtitutions*.

II. *What Conſcience is.*

By the Word CONSCIENCE we here underſtand, that *Teſtification* or *Witneſſing* to *Good* or *Evil*, which every one experienceth in his own *Mind*: Or, as ſome deſcribe it, it is *that Act of the Intellect whereby a Man judgeth, that a thing ought, or ought not to be done*. And this *Act* or *Conſcience*, is denoted by ſeveral *Names*, according to the *Motives* or *Reaſons*, whereby it is egg'd on.

III. *A Right Conſcience.*

It is called *Right*, when the *Human Underſtanding* is ſo well informed of things that are to be done or omitted, that it can give clear and diſtinct *Reaſons* of its *Perceptions*, and ſuch as cannot be doubted of or call'd in *Queſtion*. Or, to expreſs the ſame in fewer Words, which dictates that to be *Good*, which is Good; and that to be *Evil*, which is really ſo. And ſuch a *Conſcience* as this, is but rarely found amongſt *men*, there being but very few that know the *Cauſes* of *things*, and that are ſo happy as to be able to reduce them to their *Principles*.

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IV. *A Probable Conscience.* We call that a *Probable Conscience*, when tho' we do truly assent to the *thing* offer'd to us, and do think that the same ought to be embraced or declined; yet we are not able to make out our *Judgment* by *Reasons*, but only derive the same either from the Authority of our *Superiours*, or received *Custom*, or the common tenour or course of a *Civil Life*.

V. *A Doubtful Conscience.* A *Conscience* is said to be *Doubtful*, when it hangs, as it were, in equal poize or wavering, and doth not know which part to assent to: Which more especially is found in singular Cases; where *Reasons* on both sides present themselves, and we cannot discern which are to be preferr'd. Now in such a case as this, we do well to suspend our *Judgment* without determining any thing till the Darkness of our *Mind* be dispell'd, and that it clearly appear to us, what is consonant to the *Law* before us, and what is contrary to it.

VI. *An Erroneous Conscience.* Lastly, We call that an *Erroneous Conscience*, when our *Understanding* embraceth *Evil*, instead of *Good*, or declines *Good* instead of *Evil*. And this either through Vincible or Invincible *Errour*. *Vincible Errour* is that which we may avoid by a diligent and careful Examination of the Case. *Invincible*, is that, which we cannot avoid by any care or diligence that it is possible for us to take. But this last *Ignorance* happens only in particular Affairs, which depending of many *Circumstances*, it frequently comes to pass, that we are deceived about them, or about the *Object* it self, and so fall into *Errour* against our *Wills*.

VII. *What Obligation is.* By the word *Obligation*, we are to understand nothing else, but that Tye of the *Law*, whereby we are of necessity compell'd to do something. For by it we do, as it were, gird up our *Free-will*, and tho' we very well know our selves to be free, and that we can chuse the contrary to what is propounded to us: Yet there is a kind of *Coactive Power* that sticks to our *Minds*, by means of the *Obligation*, which doth not suffer us to incline to it, and puts us in *mind*, that we shall sorely repent of it afterwards, in case we do not act according to the Prescript of the *Law*.

VIII. *Man alone, of all other Animals, is capable of Obligation.* Amongst all *Animals*, *Man* only can be the Subject of *Obligation*: For *Beasts* being devoid of *Reason*, and destitute of the *Faculties* of the *Will*, can exert no free *Actions*; and therefore it would be in vain, to prescribe any Form to their *Actions*, seeing they can neither understand it, nor adjust their *Actions* by it. *Man* only therefore is capable of *Obligation*, and of receiving a Rule prescrib'd by his *Superiour* to Live by. I say, by his *Superiour*; for if a *man* were of such a Condition, as to be wholly at his own dispose, without being obnoxious to the Command of any, he could not be obliged to the performing of any thing by any *Law*; and if in that *State* he should follow the dictates of *Reason*, and abstain from some things; this would be imputable rather to his most *Free-will*, than to any *Obligation* lying upon him.

IX. *How a Superiour is to oblige those that are under his Command.* Now to the end that this *Obligation* may be the more firmly impress upon the *Mind* of *man*, besides the *Authority* of the *Superiour*, it is sometimes fitting that Just Causes should be produced by him, which induce him to put this Curb or Restraint upon the Liberty of his *Subject*. For he that only shews his *Power*, and will always have his *Will* to stand instead of *Reason*, may indeed strike *Fear* into a *Man*, and make him rather chuse to obey him, than to expose himself to danger: But when once this *Fear* is gone, and that the *Superiour* ceaseth to be frightful to him, he will soon return to his own Inclinations, and follow the Motions of his own *Will*, rather than those of another. But when the *Reasons* are discover'd, why he thinks fit to circumscribe the *Liberty* of his *Subject*; and that he makes it out, that it is his Interest that such *Laws* should be Enacted; yea, that many Advantages will thereby accrue to him, he will readily submit himself to them, and shew himself ready to obey his Princes *Commands*.

X. *The Rule of Human Actions.* The *Rule* therefore which every *man* is to follow in his *Actions*, is the *Law* or *Decree*, whereby the *Sovereign*, in whom the *Publick Power* is lodg'd, binds up his *Subjects*, to order and regulare their *Actions*, according to his *Prescript*. Now that such a *Law* may be able to compel *men*, and exert its Force upon their *Minds*, it is necessary that the *Legislator* and his *Laws* should be known to them. For how will any one be able to pay *Obedience* to them, if they have no certain Knowledge, neither of the *Person* to whom they are to render it, nor to what they are obliged? True it is, that the *Laws of Nature* are engraven on the *Hearts* of all *men*, and are so many *Precepts* that are common to all *Nature*, and that no Man in his *Right Understanding* can be ignorant of the *Author* of them: But *Civil Laws* are not alike Notorious, as depending upon the *Free-will* of *Superiours*, as being such to which only some peculiar *People* are obliged; and therefore in order to their being of Force, they must be promulged and made known to all their *Subjects*. Which Promulgation is performed, either by the *Voice* of the *Legislator* himself, or by some of his *Deputies*, whose Authority is unquestionable; or any other way, according to the various Customs of different *Provinces* and *Kingdoms*.

XI. *There are two things in every Law.* Every *Law*, if it be perfect, contains 2 Parts: The *one* which determines what is to be done or omitted; the *other*, which declares the *Punishment* to be inflicted upon those that neglect to perform what is prescribed, or commit what is forbid. For seeing that *Human Nature* is prone to *Evil*, and is apt to be carried with more vehemence to things that are forbid, it would be to little purpose for any *man* to declare what is to be done, if there were no *Punishment* to follow the Contemner of the said *Command*: And so in like manner, it would be altogether to no purpose to threaten any *Punishment*, if there were not cause specified before, for which the said *Punishment* is to be inflicted.

XII. *Laws are to be Enacted for the Publick Good.* Notwithstanding that *Laws* seem to restrain the *Liberty* of the *Subject*, yet they are so to be ordered, as that whatsoever is prescribed, may appear to be profitable and advantagious to the Publick Good. For it would seem unjust to oblige *Subjects* to the Observance of any thing that is not advantageous thereunto. Forasmuch as *Laws* are like *Remedies*, which ought always to be conducive to the good State of the *Body*, because they are appointed for that end: And in like manner, there ought to be nothing in the *Laws*, which doth

not contribute to the good of the *Community*, because it is for that Reason that they were Enacted.

XIII. *The Legislator may dispense with the observance of the Law.* Tho' the *Law* be suppos'd a *Common Precept*, and *a common Contract* or Agreement (as the *Lawyers* express it) *of the Commonwealth*, according to the *Prescript* whereof those that live in the *Commonwealth* are to regulate themselves; yet some *Persons* may be peculiarly exempted from the observance of it; and this is exprest by the word *Dispensing*. The Power whereof belongs only to the *Legislator*, who as he hath the Power of Enacting *Laws*; so he only hath the Power of Abrogating or Dispensing with them, that is, delivering any one from the obligation of them. But above all things, it is the *Duty* of the *Sovereign* never ordinarily, or without urgent Cause to free any of his *Subjects* from the obligation of the *Law*; to avoid the Envy and Indignation this would be apt to cause amongst their Fellow *Citizens*.

XIV. *The Difference of Actions.* From what hath been said, may be gather'd, that *Human Actions*, as they have a relation to the Prescript of *Laws*, do take to them several *Qualities* and *Denominations*. For those which the *Laws* pass by, without determining any thing concerning them, are called *Permitted* or *Lawful*, as long as they are not contrary to the *Law* of *Nature*, or the *Reason* that is in *man*. The *Actions* that are conform to the *Laws*, and follow the *Rules* prescribed by it, are called *Good*; and those *Evil*, which are contrary to it.

XV. *When Actions are said to be Good.* Now to the Goodness of an *Action*, it is requisit not only that it agree with the *Law* in some part, but that it be in all things conform to it: Whereas it is sufficient to the Pravity of an *Action*, if it be deficient in some one part only, and does not in all respect, agree with the *Law*.

XVI. *The Divine and Human Law.* The *Law*, as it is a Regulation of *Reason*, shewing Man what he ought to do, and what not is twofold, *Divine* and *Human*. That is called the *Divine Law*, which is instituted immediately by GOD himself. And therefore ARISTOTLE saith, in his *Third Book* of *Politicks*, *He who commands the Law to bear Rule, commands that GOD should bear Rule. Human Law* is that which is Enacted by *men*, and is different according to the different Form of the *Government Politick*. Of which I have treated more at large in the *Chapter* of the *Law* of *Nature*.

CHAP. XXIII.

Of the Duty of Man towards GOD.

I. *Of the three general Duties, or Offices of Man.* THE *Action*, which according to the Nature of the *Obligation* that lies upon us, we are to regulate according to the *Præscript* of the *Laws*, is divided into 3 Chief Parts, according to the several *Objects* it respects. The first whereof shews, how according to the sole Guidance of *Nature*, we are to carry our selves towards *GOD*; the other, how we are to demean our selves with regard to *our selves*; the last, how we are to comport our selves towards *other men*. For the whole *Obligation* of *Man* is compriz'd in these 3 *Duties*; so that he may be said to have performed whatsoever appertains to him, if he carries himself *Piously* towards *GOD*, *Prudently* towards *Himself*, and *Equally* towards his *Neighbour*. Wherefore seeing that the *Duties* we owe to *GOD*, do precede the other 2, we shall first speak of them, and afterwards proceed to the other.

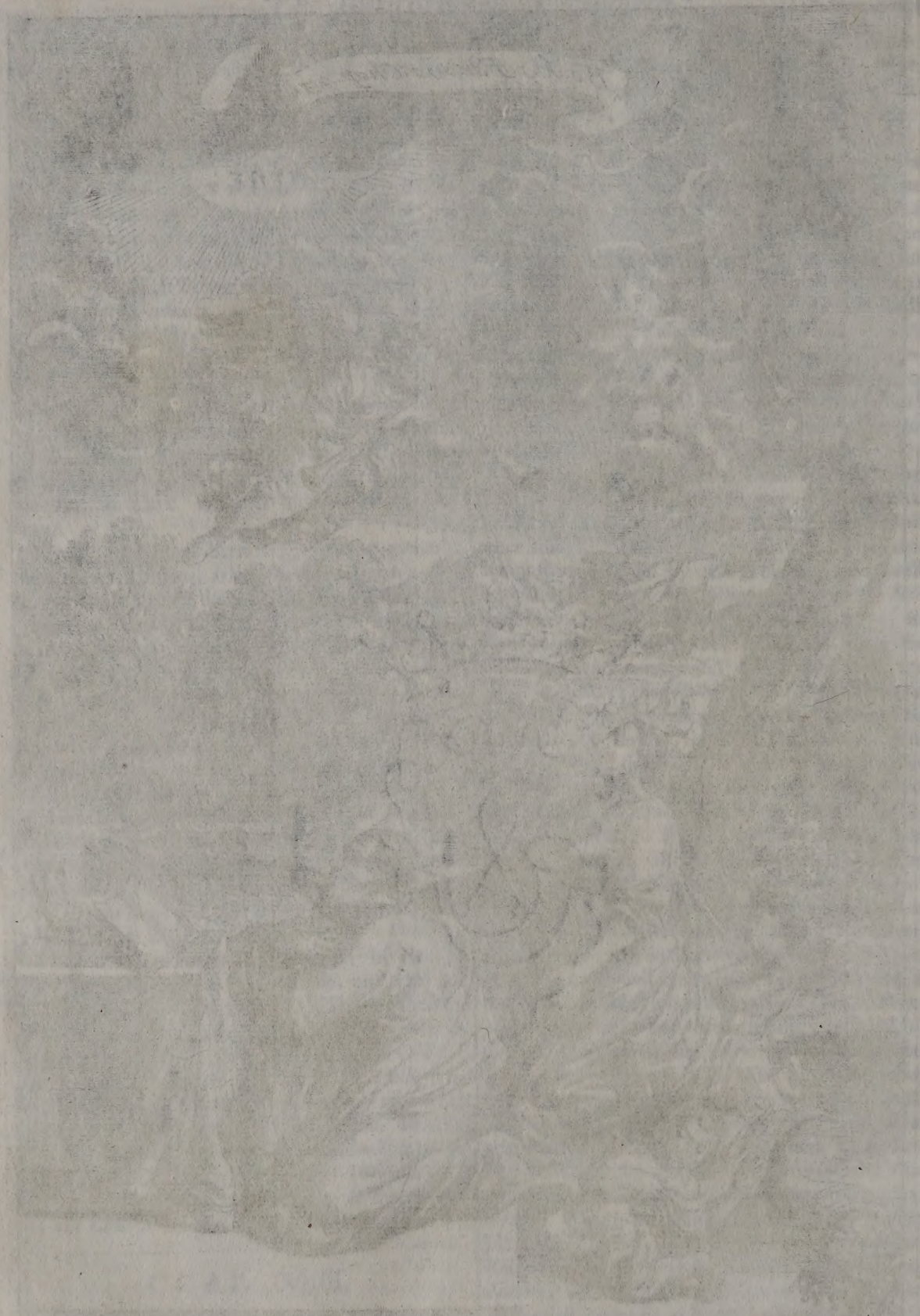
II. *What is Man's Duty towards GOD.* The *Laws* whereby *Man* is obliged towards *GOD*, may be reduced to 2 Heads: *First*, That he have right Thoughts concerning *GOD*, and a true Idea of his *Nature* and *Perfections*. In the *next* place, that he resign and conform his own *Will* to the *Divine*; and that he look upon it as the greatest of Crimes, to deviate in the least from his Good Pleasure. And from these two parts of *Man's Duty* towards *GOD*, many Propositions, both *Theoretical* and *Practical*, may be deduced, whereon *Natural Religion* is founded, and by which, according to the Etymology of the word, *Religion*, a *man* is ty'd and obliged.

III. *The First thing we are to hold concerning GOD.* The *First* thing we are to hold concerning GOD is, that he *Exists*; that is, that he hath an *Actual Existence*, and is the *Principle* of all other things. This being no more, but what is demonstrated to us by the Amplitude and vast Extent of the *Universe*, the unconceivable Variety of it, and the Beauty and Harmony of its Parts; since none of all these could have the constant Continuance and Regularity they are found in, except the *World* were at the Command of a most *Wise Governour*, and did persevere by an immutable *Law*. By this *Contemplation* alone of the *World*, the *Philosophers* of old attain'd to th Knowledge of GOD, as being fully convinc'd, that such an Exquisit and most absolute *Work*, could not proceed from less than an *Omnipotent* and most *Perfect Being*. If some *Modern men*, that aspire to that *Name*, seem to be of another *Opinion*, it is to be attributed to their *Ignorance*. For as a confus'd Perception of things, and Superficial Knowledge incline *men* to *Atheism*; so a clear and profound Knowledge of *things*, raiseth the *Mind* to the *Veneration* of GOD, and not only excites it, but even strongly compels it thereto. 'Tis *the Fool* only that *saith in his Heart, there is no GOD*. For whole Mankind, from the very Beginning, ever was in perpetual possession of this *Truth*, seeing there was never any *Nation*, (as TULLY expresseth it) so Barbarous or Savage, that did not own a GOD, tho' it may be they were not able to determine what kind of Being he must be. And accordingly JUSTINIAN, 2 *F. de Just. & Jur.* reckons *Religion* towards *GOD*, amongst the *Laws of Nature*, and *the Right of Nations*; forasmuch as all *Nations* agree in a general *Worship* of *GOD*, and, as it were, by the Attraction of this common *Principle*, are united and reconciled.

IV. *The Second thing is, that GOD is the Creatour of the World.* The *Second* is, That GOD is the *Creatour* of the *World*, and that nothing is to be found in it, whereof he is not the *Author*. For since this glorious *Fabrick* of the *Universe* could not be its own *Cause*, what Contrivance, what *Engins*, what *Leavers*, what *Servants* could be employ'd in the Production of it, but the *Omnipotence* of *GOD* himself? Hence appears the Ridiculous and stupid folly of the EPICUREANS, who suppose that so many *Miracles* were the product, not of the *Divine Reason*, but of the fortuitous concourse of *Atoms*. For how could these *Atoms*, in those immense Spaces, meet in such

To the Right Worshipfull S.r James
Edwards of the Citty of Yorke Baronet

This Plate is humbly Dedicated by Richard Blome



a manner, and be adapted together, as to compoſe *Animals* and *Man*, whereas we ſee they cannot be produced without the mediation of *Seed*? What Cauſe was there to diſpoſe them rather to the forming of this *Body*, than another? What was there to determine them to the conſtituting of *Bones*, *Fleſh*, *Marrow*, *Veins*, *Arteries*, *Nerves*, *Humours*, *Tendons*, *&c.*? We muſt therefore acknowledge a *Special Principle*, by whoſe Power this *World* was framed, and all the parts of it digeſted in the comly Order in which we ſee them.

V. *Thirdly, That He is the Preſerver of the World.*

The *Third thing* we are to hold concerning *GOD*, is, that he is the *Governour* and *Preſerver* of the *Univerſe*. As is evident from the admirable Order and Agreement of the Parts of it, which could not continue ſo long invariable, if they were not by ſome Supream Cauſe preſerved in the ſame Condition. For daily Experience teacheth us, that whatſoever is made up of different Things, and are endued with different Powers, do ſtand in need of an *Upholder*, and will eaſily run into Confuſion, except they be ſupported by an *External Agent*, and their Parts kept in their due Stations. And therefore the *Ancients* were of Opinion, that *GOD* had ſomewhat of the ſame place in the *World*, as a *Coach-man* in a *Coach*, the *Singing-Maſter* in a *Choir*, the *Steers-man* in a *Ship*, the *Father* in a *Family*, and a *King* in his *Kingdom*. And that conſequently, thoſe who deny that *GOD* takes care of this *World*, and that all things therein are managed by his Conduct, are as Criminal Delinquents againſt his *Divine Majeſty*, as they who ſay, there is no *GOD* at all.

VI. *And, that he hath a Special care of Mankind.*

We are likewiſe to conſider, that *GOD* not only Governs the whole *World*; but that he alſo Exerciſeth a more Special Conduct towards *Mankind*, and that he is the *Immutable Cauſe* of all the Actions which depend on the *Free-will* of *Man*. For ſince it cannot be demonſtrated, that he doth *Exiſt*, except that he be conſidered as a moſt *Perfect Being*; and that he could not be ſo, if there were any thing in the *VVorld* that did not proceed from him; conſequently we can prove from *Natural Philoſophy* alone, that not the leaſt *Thought* can enter into the *Soul* of Man, without the Will of *GOD*, and except *GOD* had Will'd it ſhould from all Eternity.

VII. *Fourthly, That he is moſt highly Perfect.*

The *Fourth thing* we are to be perſuaded concerning *GOD*, is, that he is *Sovereignly Perfect*, and that no *Attribute* belongs to him that implies the leaſt defect. For ſeeing that he is *Infinite*, he muſt of neceſſity include all thoſe Perfections which the *Mind* of Man is capable of Conceiving; and conſequently we muſt own him to be *Sovereignly Good* and *VViſe*, *Eternal*, *Omnipotent*, *Immenſe*, and ſo *Perfect*, that it is equally impoſſible to addany thing to Him, or take any thing from Him. But foraſmuch as the *Divine Perfections* cannot be comprehended by any *Human Underſtanding*, in order to the Expreſſing of them, we ſhall make uſe of ſuch Terms, as ſhall more magnificently unfold his *Supream Excellence*, and impreſs upon us a greater Veneration. For when we hear that *GOD* is *One*, *Immenſe*, *Incorporeal*, *Immortal*, *Infinite*, *Incomprehenſible*, *&c.* we ſeem to launch into a Boundleſs *Ocean* of Perfections, and are forc'd to confeſs, that the Amplitude of ſuch an *Eſſence* can by no means be reached by our *Intellect*.

And accordingly they Sin againſt the *Law* of *Nature*, who ſay, that *GOD ſees things, before ever he did determine himſelf to Will them; that he conſults the Order of his Acting, before he Acts; that his VVill indeed is, that there ſhould be no Monſters; but that the ſimplicity of the Laws of Motion doth neceſſitate him to ſuffer them*; and other ſuch like, which import Dependance and Imperfection in *GOD*.

VIII. *Nothing muſt be attributed to GOD, that includes either Dependance or Imperfection.*

Wherefore we are to remove from Him whatſoever implies any Limitation or Defect, and all thoſe *Affections* which imply or ſuppoſe the want or abſence of any *Good*. And if we find, that *Paſſions* are ſometimes attributed to *GOD*, as when the *Scripture* ſpeaks of his *Favour* and *Munificence* towards thoſe that are *Good*, and his *Vengeance* againſt the *VVicked*; we are to remember that the *Scripture* in theſe Expreſſions, accommodates its ſelf to the Capacity of our *Human Underſtanding*. In like manner we find, that *Holy VVrit* attributes to *GOD*, *VVrath*, *Jealouſy*, *Indignation*, *&c.* by a *Metaphorical* way of Expreſſion accommodated to our Weakneſs, and rather deſigning to repreſent to us the Effect of that Affection, than the Affection it ſelf.

IX. *We muſt remove from GOD every Imperfection.*

In like manner, thoſe alſo Sin againſt the *Law* of *Nature*, who attribute to *GOD* any *Figure*; becauſe every *Figure* is determined and bounded: Thoſe who ſay, that *GOD* is compoſed of *Parts*, or that he is a *VVhole*; becauſe all theſe ways of Speaking import *Attributes* that belong to *Finite things*; and thoſe alſo who ſay, that *GOD* is in a Place, becauſe nothing can be in a Place, but muſt have its Greatneſs or Bulk bounded on every ſide. Thoſe alſo Sin againſt the ſame *Law*, who aſſert, That *GOD* Moves himſelf, or that he Reſts, becauſe both theſe ſuppoſe the being in a Place, which is inconſiſtent with *GOD*.

X. *Such as Figure, Motion, Parts, Place, &c.*

Neither is it enough for Man to *know GOD*, but he muſt alſo *worſhip* and celebrate him. For the *Practical Propoſitions* whereof *Natural Religion* doth conſiſt, are converſant about the *VVorſhip* that is due to *GOD*, which is partly in the *Mind* of Man, and partly without it; that is, either Inward or Outward. By the *Inward VVorſhip*, we underſtand the *Honour* that is to be given to *GOD*, in conſideration of his *Power*, in Conjunction with *Goodneſs*. For *Veneration*, as was ſaid before, is an Inclination of the *Soul*, not only to have high Thoughts of *GOD*, whom it *worſhips*; but alſo to ſubmit and reſign it ſelf to him, with a kind of *Awful Fear*, to obtain his *Favour*. And therefore no Man *Honours GOD* more, or ſerves him with a purer *VVorſhip*, than he, who by the *Holineſs* and *Innocence* of his Life endeavours to become like him, and would rather *dye* a thouſand Deaths, than to ſuffer that Holy *Image of GOD*, which he diſcerns and owns within himſelf, to be defiled by any *Crimes*, or ſtained with any the leaſt *Vice* or *Immorality*. And from the Conſideration of his *Glorious Majeſty*, he is ſtirr'd up to deſire him, as his *Author* or *Maker*; to love and call upon him, as his *Father*; to honour him, as his *King*; and to fear and reverence him, as his *Lord*.

XI. *GOD is to be Honoured by Man.*

In order to the eaſie acquiring of this *Habit* of *Loving* of *GOD*, and the having a moſt profound *Fear* and *Reverence* for him; we muſt frequently reflect, that *GOD* commands us nothing, but what is for our Profit or Advantage, and that his Power and

XII. *After what manner GOD is to be beloved by us.*

and *Goodness* are so Great; that He hath Created an infinite Number of *Beings*, which serve for our Preservation; which Consideration will fill us with so much *Admiration*, *Respect* and *Gratitude* for our Great GOD, that knowing him to be the Source of all True *Good*, we only and above all things shall desire to be united to him with our *Wills*, and to *love* him in the most perfect manner possible.

XIII. *With Outward Worship.* Neither are we only to render unto GOD the *Inward worship* of our *Hearts*; but we must also give unto him that which is *Outward*; which we then do, when in Thankful Remembrance of his Benefits, we render Thanks unto him, and acknowledge him to be our Beneficent *Father*, GOD and LORD; and by our *Hearts* or *Eyes* also lifted up unto *Heaven*, do admire his *Power* and praise his most *Holy Majesty*. When in a deep sense of our own Infirmities, we *pray* unto him, implore his Assistance, and humbly beseech him to help and succour our *Infirmities*; and that he would be pleased to bestow upon us those things he knows to be *good* for us, and to turn away from us all things that are *hurtful*. Whilst we abandon and resign our selves wholly to his *Will*, and in all things complying with the same, and embracing whatsoever happens to us, as that which from all *Eternity* was Decreed concerning us. Wherefore let our Modern *Upstarts* take heed, that they do not too curiously search into the *Nature*, *Decrees* and *Government* of GOD: But rather entirely persuade themselves, that he is most intimately acquainted with what is most Expedient for us; and that it is impossible, but that he who Loves all things, Does all things, Perfects all things, and Contains all things, should not always do the best of all in all Cases whatsoever.

XIV. *And in Publick places.* Neither is it sufficient for us, to offer *Innocent* and *Holy Hearts* to GOD, and to *pray* unto him in the secret Retreats thereof; but it is moreover required, that we pay him our *Devotions* openly, and in Publick places. For who is there that believes GOD, and can be asham'd to *pray* unto him, to *praise* him, and to offer Himself, and all his Powers and Faculties, for a whole *Burnt-Offering* unto him? *Fear* or *Shame* in this case, is a mark of *Degenerate Souls*; neither can he be said truly to *worship GOD*, who is asham'd to render him the *Veneration* that is due to him, and openly to profess, what in the most inmost Recess of his *Heart* he owns and adores. And on the contrary, when in the *Churches* and Publick places of *worship*, we render him the Glory that is due to his *Divine Majesty*; testifie our *Devotion*, and are Zealous for his *Honour*; we by our Presence and Examples do also incite others to exhibit the like *Honour* and *Reverence* to him.

CHAP. XXIV.

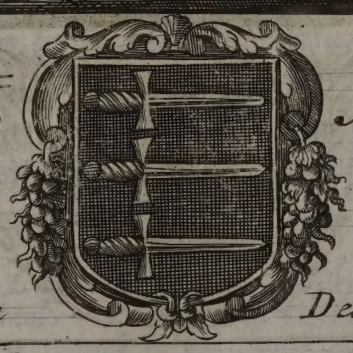
Of the Duties of Man towards himself.

I. *The First Duty is, That he be a good Member of the Society.* MAN being most dear unto himself, and having his *Eyes* fix'd upon his own Good and Welfare, as the Center from whence all his Operations flow, and to which they return: It seems altogether superfluous to prescribe *Laws* unto him, to take care of himself, procure his own *good*, and advance his own *interest*. But forasmuch as *man* was not born for himself only, but made by GOD for the good of *Human Society*, he ought so to behave himself as to be a fit Member of the *Body Politick*, and that as far as his state and condition permits, he be of use and service to the same. For no body is exempt from this *Law*; for how dull and stupid soever a *man* may be, and unfit for *business*, yet he makes himself obnoxious to the *Laws*, when he is not serviceable to the Community by some Art, Employment or otherwise. Every one must take care therefore that he be furnish'd with *Vertue*, Good *Manners*, and a *sense* of what is Good and Right: for as the *Soul* excells the *Body* in Dignity, and commands the whole *man*; so great care is to be taken in the improvement of it, to the end the *Body* may be obedient to its conduct, and perform its *motions* according to the *Rules* of *Reason*: wherefore every one is bound according to his *fortune* and natural gifts, to betake himself to some *Profession*, *Art* or *Science*, and choose to himself such a way of *living*, that he may not for the future, be burthensome to himself or others, or a useless *member* of the *Society* he belongs to.

II. *How our Body is to be Governed.* And as we are to take care to furnish our *Minds* with *Arts* and *Learning*, so we are to bind our *Body* to its good Behaviour, lest being pamper'd it become unruly, and prove refractory to its Lord and Master the *Soul*. Accordingly we must take heed to *feed* it with necessary *food* only, and exercise it with *labour*, lest by intemperance in *eating* or *drinking* it run headlong into filthy *Lust*; and being dull'd and stupified by *Idleness* and inactivity, it become a clog and dungeon to the *Mind*. And forasmuch as the *Passions* do arise from the conjunction of the *Soul* and *Body*, and derive their force and strength from that unequal *Society*, all diligence must be used for the restraining and moderating the same, and timely quelling their first *motions*. For the *Passions* are like *Souldiers* that attack a place, who except they be beaten off at their first coming on, easily make themselves Masters of the *Place*, and take *Prisoners*, or cut down all they find in it.

III. *It is not lawful for a Man to kill himself.* Yet it is not lawful for any *man* to lay violent hands upon himself, to be delivered from the violence of his *Passions*, or from those *Evils* that are incident to the *Body*. For he *sins* against *Nature*, who being impatient of the *Evils* he groans under, cuts off the Thread of his *Life*, and because he cannot *live* as he would, will not *live* at all. *Man* must remember that he is appointed by *God* to be, as it were, the *Guardian* of his own *Life*, not the *Executioner* or Tormentor of it; to whom he proves faithless, when-ever he treacherously surrenders himself to the Calamity that assaults him, which he ought couragiously to resist and overcome; or else at the apprehension of shame or danger, or being wearied out with pain or trouble, puts an end to his *Life*. For by this *Despair*, not only GOD is offended by the destruction of his *Workmanship*, but the *Commonwealth* suffers also by the loss of one of her *Members*. And therefore it is that the *Laws* take up *Arms* against these their profest *Enemies*, and order them to be cast out without *Burial*, forbid any Pious Remembrance to be made of them; and if they fail'd in their design of dispatching themselves, brand them with

To the Worship=full Thomas
Raulins of Kilreeg in
Hereford shire Esq.



This Plate is humbly Dedicated by Richard Blome.

To the Right Worship-
full S.r Gilbert Gerard
Cosine of Brafferton
hall in the North
Rideing of Yorkeshire
Baronet. Grandson
of the Right Revernd
Father in God John
Cosine late Lord
Bishop of Durham.

This Plate is humbly
Dedicated by Richard Blome

with a mark of perpetual *Infamy*. VALERIUS MAXIMUS tells us, that it was a Cuſtom amongſt the *Athenians* to make thoſe who were ſentenced to death to drink *Poiſon*, which afterwards was for good reaſon abrogated, for that it ſeems to be an unbecoming and unnatural thing, that a *man*, who above all things loves himſelf, ſhould be made to haſten his own *death*, and contrary to the natural *Law* of ſelf-preſervation, ſhould prove his own *Executioner*. We are to wait therefore till he who hath placed us in the Poſt where we are, do call us away, and diſmiſs us from the *Theatre* of the *World*.

IV. *A man is bound to reſiſt him that ſets upon him.* *Man* therefore being bound to *preſerve* himſelf, it follows that he ought to defend himſelf from the Aſſaults of an Aggreſſor, and to repel his force by force, if there be no other way left for him to avoid it, or to flee from the danger. For tho' by *killing* of our *Enemy*, the *Commonwealth* ſuffers loſs, and the ſame as if he who defends himſelf were killed; and that every man is bound to procure the common Good, Safety and Proſperity of the *Commonwealth*, and of every one of the *Members* thereof; yet this is only ſuppoſing that his *perſon* be not endanger'd thereby. For no *Law* can oblige us to betray our own ſafety, and conſpire our own *Ruin*, to ſave a wicked perſon. Yea, every one hath a natural and inborn right, to ſtave off any violence done unto him, with all his might. For if it were otherwiſe, who could be ſaid to be the *Poſſeſſor* of any thing he had, if it were lawful for *Robbers* to deprive him thereof, without his daring to oppoſe them, and to reſcue his *goods* out of their *hands*? For what is it elſe to prohibit a mans defending of himſelf and his own *Goods*, but to drive *Juſtice* out of the *World*, and to beſtow upon *Thieves* and *Robbers* that which is the property of other *men*?

V. *That we ought to ſpare even the Life of our Enemy* Yet muſt not we in this juſt defence of our ſelves endeavour to take away the *Life* of our *Enemy*, if there be any other way for us to avoid his fury; as for Example, by hindring his acceſs to us, by getting into a ſafe place, or by exhorting our *Enemy* to deſiſt from his intended Cruelty.

VI. *Eſpecially if he repents and cries Pardon.* And if it happen that the *Aggreſſor* do repent of the *Injury* he hath done us, begs our *Pardon*, and promiſeth to make amends for the hurt he hath given us; in this caſe, he that is affronted or ſet upon, ought to be reconciled to him, and leave all thoughts of *Revenge*. For his Repentance ſhews him to be changed, and that he is no longer an *Enemy*: And the very *Law* of *Nature* commands us *to forgive the paſt faults of thoſe who repent that ever they have affronted or offended us, and who ask Pardon for it*. Except it ſhould be made manifeſt that this *Repentance* was only the effect of force, and that the Offender did not deſire *Pardon*, and to be reconciled, but only becauſe his *Arms* or his ſtrength fail'd him: For in this caſe, we ought to lay hold of him, leſt recovering his ſtrength he ſhould ſet upon us unawares.

VII. *How he is to behave himſelf who lives under a Magiſtrate.* He who is obnoxious to the *Laws*, may lawfully be made an Example, whenſoever time or place will permit a man to have recourſe to his Superior, for his *ſafeguard* and protection againſt the violence and aſſaults of his *Enemy*. Hence it is that *Thieves* and *Robbers* are lawfully kill'd, neceſſity putting *Arms* in our *Hands* to defend our ſelves, and what belongs to us. But where we can have recourſe to the *Magiſtrate*, we are to bring them before him, that offer us any *violence* or *injury*; it being only for want of this, that we may make uſe of the Right which the *Law of Nature* gives us, and by repelling force with force, take away the *Life* of the *Aggreſſor*.

VIII. *Thieves may be lawfully killed.* As we may kill a violent *Aggreſſor*, ſo likewiſe do the *Laws of Nature* permit us to kill a *Thief*, that endeavours to *rob* us of our *Goods*. For theſe external things are the *means* whereby our *Lives* are maintained, and in the preſervation whereof our *State* and *Honour* depends. Hence *Lawyers* call theſe outward *Good things* the *Life* and *Blood* of *Men*, which may be defended at the hazard of another mans Life, as well as *Life* it ſelf. And tho' in *Cities* ſometimes the *thing* ſtolen may be recovered by the help of the *Magiſtrate*, yet no man is bound to ſuffer the taking away of his *Goods*, becauſe he may probably afterwards recover them; foraſmuch as he hath not only a right to recover them when ſtolen from him, but alſo to preſerve and keep them from the violence of others. And if this be ſo, that a man may defend his *Goods* at the peril of the *Aggreſſor*, I ſee no reaſon why a *Woman*, whoſe Chaſtity is attempted, may not kill the *Raviſher*; ſeeing a *Vertuous Woman* hath nothing that is dearer to her in this *World*, than her *Honour* and *Chaſtity*, and that no greater loſs can happen to her, than to be by force deprived of the ſame.

CHAP. XXV.

Of the Laws we are to obſerve with reſpect to other Men.

I. *The Duty of Man towards others conſiſts in two things.* THE whole *Duty* of a *Man* is contained in behaving himſelf *Reverently* towards *GOD*, *Prudently* towards *Himſelf*, and *Juſtly* towards his *Neighbour*. The two foregoing parts of *Mans Duty* we have already ſpoken to, and now proceed to the laſt. The *Duty* therefore of a *Man* towards others, *Firſt* of all conſiſts in this, that he obſerve an Equality, and do not prefer himſelf before others. *Secondly*, That he hurt no *man*. For the peculiar *Law* of *Man*, as he is a Reaſonable Creature, according to JUSTINIAN § *Inſtit. de Juſt. & Jur.* is reduced to theſe three *Precepts, To live Honeſtly, not to hurt another, and to give to every one his Right*. Now he gives to every *man* his *Right*, that doth not prefer himſelf to any; but being mindful of his *Human Condition*, embraces all with an equal *Love* in the like Circumſtances. For tho' a *man* excel others in *Vertue*, exceed them in bodily *Strength*, be above them in gifts and endowments of *Mind*, and do more abound with *Goods* of *Fortune*; yet is he for all this never a whit the leſs bound to obſerve the *Laws* of *Nature*, nor hath he therefore any more Right to hurt others, than they have to injure him. For as *Nature* is benign and kind to all, and equally diſpenſeth to all the deſire of *Truth* and *Right*; ſo likewiſe there ought to be an equal *Charity* maintain'd amongſt *men*, and the ſame common *Offices* of Good-will one to another. For there is nothing more conducive to the preſerving of a *Sociable Life*, than for *men* to do by others,

as they would have others do by them; and for them not to expect or require any thing from others, but what they would as willingly, that others should demand of them.

II. *Equality is to be preserved amongst all Men.* In order to the putting of this Equality in practise, it will be very conducive well to weigh and consider our *Nature* and *Original*, viz. that we were all formed out of the *dust* or *mould* of the *Earth*, and came all of us into the *World* after one and the same manner; and that being nourish'd by the same *Aliments*, we after some years arrive at Old *Age*, and at last all of us alike submit to *Death*.

III. *We are to return one good turn for another.* This Equality amongst *men* thus supposed, it follows, that if we desire the helping hand of others, and their assistance in any of our *affairs*, we must be every whit as ready to lend them ours, and to procure their good and advantage. For he would be unjust, that should make use of anothers help for the promoting of his own *Interest*, and looking upon it as his due, should not be ready to do the same service to the party that had obliged him by his assistance. Wherefore as they take most care for the good and advantage of the *Society*, who do not allow themselves any more than they would gladly allow to another: so that person ought to be lookt upon as an overturner of the *Society*, who affects a superiority, and expects *honour* or *Service* from others, and in the mean time disdains to return the same again to them. Hence by the *Law* of *Nations* this Permutation or Exchange hath been introduced, *whereby I willingly grant unto thee the thing thou dost demand of me, upon condition, that thou in like manner do grant unto me, another thing I ask of thee, having first made a tacit estimate of the value of both things with our selves.*

IV. *No Man hath Right to prefer himself before another.* Those are defective in the performance of this *Duty*, who, because of their *Riches* would be preferr'd before others; and despising the *Equality* whereby Nature hath level'd all of us, and set us upon even ground, do conceit a vast distance betwixt themselves and others: whereas it would be much more becoming them to call to mind the manifold weaknesses incident to *human nature*; the *Errors* and faults they have formerly committed, and are still obnoxious to; the *Passions* that domineer over them, and to whose motions they are as much enslaved, if not more, than others. Moreover, forasmuch as there is nothing Praise-worthy in *man*, save only what proceeds from his *Free Will*, there is no reason why any one should prefer himself before another, since they may as duly make use of their *Reason*, and with equal constancy continue in the purpose of doing those things which *Reason* persuades and recommends to them. For in this firm purpose doth the very *Essence* of *Vertue* consist, and which may be found as well in a *Commoner* as in a *Prince*, in a *Poor Beggar* as in a *Rich Man*. Nothing more becomes a man of a generous temper, than vertuous *Humility*, which consists in this, that a *man* seriously consider *Human* frailty and weakness, which he finds in himself as much as in others.

V. *No Body is to be despised or flouted at by outward remarks of contempt or derision.* But their fault is yet more gross and inexcusable, who undervalue and trample upon others, not only by inward disesteem and contempt, but also by some outward signs, as by *Words*, *Looks*, *Laughter*, do flout at and vilifie others. Which offence is the more criminal, forasmuch as this *behaviour* is exceeding provoking, making the party so derided to be inflamed with *Anger*, and to be strongly moved to seek for Revenge. For so impatient is the *Mind* of *Man* of Affronts, that many are not affraid to hazard their *Lives* to revenge them, and will rather violate a long continued Bond of *Friendship*, than to bear an open and petulant abuse. For a *Mans Reputation* and *Good Name* is wounded thereby; as we find daily, that he is oft undervalued by others, who suffers himself tamely and cheaply to be abused.

VI. *No Man must be hurt by us.* Another *Duty* every *man* is to practise towards his *Neighbour*, is *to hurt no Body*. For it is the *Law* of *Nature*, 206 *F. de Regul. Jur. That no Man make himself Rich at anothers Cost.* The *Equity* of this Precept may be gathered from the consideration of *Man*, both as he is a *Singular Person*, and as he is a *Member* of the *Commonwealth*. For as it is contrary to *Heat*, to be the cause of *Cold*; and to *Moisture* to cause *Dryness*; so it is contrary to the Nature of a *Just Man*, to offend his Equal, or to provoke him by doing any hurt or injury. Thus DEMONAX, the *Philosopher* in *Lucian*, boasts himself, that he never went to Law, never was troublesom to any, but always was a *Friend* to all, and an *Enemy* to none. In like manner it is also the property of a *Good Man* not to hurt any. For Nature hath ordained a kind of Alliance and Consanguinity between *Men*; whence it is criminal and highly unjust for a *Man* to lie in wait for another, to betray or cheat him, or to invade what belongs to his *Neighbour*; because by this means the Communion between Mankind is dissolved, as the soundness and healthful state of the *Body* is overthrown, when a *stronger part* attracts the sustenance that belongs to all the rest to its self, and instead of only taking its due, usurps that which appertains to the whole *Body*.

VII. *What Harm or Damage is, and how it must be made good.* When it is said that we are not to do any harm or damage to any: By the word *Damage* is to be understood, whatsoever may cause any detriment or inconvenience to any one; such as are the *Taking way of what belongs to another*, *Depravation*, *Diminution*, *intercepting of the Rent or Income* proceeding or hoped from any thing. Because it is not only the Possession of things that is rated or valued at a Price, but also the future perception of the *Rents* and Incomes of it, in case they are surely to come to our *Hands*. Wherefore every one that harms another, either in his *Goods*, or in his *Good Name*, is bound to make *Reparation* of the *Damage* he hath done to his *Neighbour*. For a *Good Name* is the greatest of all outward *Good things*; which being once lost, all other Enjoyments are lost together with it. Now a *Man* may damage another, either *by himself*, or *by the help* and assistance *of others*: but which way soever it be done, it is always imputed to him that is the Agent, and he is bound to make *Reparation* for it. Because it is agreeable to *Reason*, that he that hath done the *Hurt*, should make amends for it, and make good the Damage he hath been the cause of, tho' he did it by another; for *he that does any thing by the ministry* or help *of another*, *does the same as if he acted it himself*. But if many *persons* do equally concur to the doing of any Harm or Damage, they are all of them bound to make

good

good the ſame, according to their ſeveral Degrees of concurrence to it. In like manner he who by his Counſel, or Advice incites another to a *Crime*, or gives him the occaſion of committing it, that himſelf may get profit by it, is bound to reſtore whatſoever damage or hurt this means may happen to the party offended. But the caſe is not the ſame with reſpect to him, who hath only given occaſion to the doing of a *thing*, or aſſiſted the Delinquents with his *Counſel*, without any advantage thereby accruing to himſelf.

VIII. *Whoſoever by his Negligence is the cauſe of the ſpoiling of any thing, is bound to make it Good.*

Neither is he only bound to make good the Damage done to his *Neighbour*, who by falſeneſs and deſign hath harmed another, but alſo who by his *Careleſneß* or *Lazineß* hath ſuffered this harm to come to him. For it is neceſſary in order to the preſerving of *Human Society*, that every one do carry himſelf with ſuch Caution, that he may be *uſeful* to the *Society*, and that he may not by his *Idleneſs* be a Burthen to any. He who by chance, and without ſet purpoſe doth hurt another, as when a *Man Fighting* among the thickeſt of his *Enemies*, doth by chance wound his *Fellow Souldier* that ſtands near him, without any ſuch intent, or knowing him to be ſo, cannot be compell'd to the making good of the hurt he hath done him. For ſeeing that the fault was committed without his Will or conſent, therefore neither can it be imputed to him; for there ſeems to be no ſufficient reaſon, why he who hath committed a fault *againſt his Will* ſhould be lyable to be amerced, rather or more than he who is *Wounded*.

IX. *Maſters are bound to make Good the Damage or Hurt done by their Servants.*

Neither are we only obliged to repair the Damage we our ſelves have done to others, but alſo that which hath been cauſed by our *Servants*, *Cattle* or other *Living Creatures*. For ſeeing that *Servants* are parts of the *Commonwealth*, they are bound to the ſame *Laws* as their *Maſters* are; and whereas they poſſeſs nothing whereby they might be in a condition, to make good the hurt they have done; it is but juſt that their *Maſters* ſhould be bound to repair it, or elſe to deliver them into the Hands of thoſe whom they have *injur'd*. For otherwiſe a *Servant*, eſpecially a *Slave*, would be at *Liberty* to hurt whom he pleaſed, if no reparation were to be had neither of him, nor of his *Lord* and *Maſter*. And the ſame may be ſaid of our *Cattle*, or other *Living Creatures* that belong to us, as when our *Cattle Treſpaß* upon other Mens *Ground*, or when they chance to *Kill* or *Wound* any Man. For ſeeing that the owner of any *Living Creatures*, makes uſe of them for his own profit, and that they are gainful to him, it is but juſt that Reparation be required of him, if he hath a mind to keep them ſtill; or if ſo be that he doth not value the ſaid *Creatures* ſo high as the damage is rated, that then they be *Killed*. It is fitting that he who knowningly hath done any prejudice to his *Neighbour*, do freely offer Reparation to him, leſt his *Neighbour* being *offended* and *provoked*, ſhould think of returning like for like: So in like manner he who hath received the injury, ought to wink at it, and be ready to be reconciled with him that hurt him. He who doth otherwiſe violates the *Laws* of the *Society*, and breaks that Peace which is the Foundation and ſupport of the *Commonwealth*.

CHAP. XXVI.

Of the Laws of Mutual Humanity.

I. *Every one is bound to be helpful to his Neighbours.*

Good-will is a *Quality*, that is inborn in the *Minds* of all *Men*; ſo that he ſeems to have ſhaken hands with *Humanity*, who is not ready to do good turns to his *Neighbour*. For it is a *Law* of *Nature*, *that every one ſhould bear Good-will towards others of his own kind*, and, as far as his condition and circumſtances will permit, endeavour to procure their *Good*. For ſince *Nature* hath made an *Affinity* and Kindred between all *Mankind*, joyning them together in a *Brotherly Band*, it is not enough for them that they do not hurt one another; but it is over and above neceſſary, that they aſſiſt and ſuccour each other. Now *Men* become uſeful to others, either in their own perſons, or by imparting ſuch *Conveniences* or good *things* to them, as are beneficial and advantageous to them.

II. *Who are uſeful, and who uſeleſs to the Commonwealth.*

By our ſelves, or in our own *perſons* we become uſeful to others, when from our very *Child-hood* we are educated in good *Manners* and Literature, and acquire thoſe *Accompliſhments* of *Body* and *Mind*, the *fruits* whereof may afterwards redound to the good of others, and our *Actions* procure *Honour* or advantage to the *Commonwealth*. And therefore they are injurious to *Human Society*, who lead a lazy and ſlothful *Life*, and indulging their *Body* only, conſider none but themſelves: And who with the *Riches* they have got, or inherited do Fat themſelves like *Hogs*, minding nothing elſe, but to *Live* as long as they can, and to Glut themſelves with *Pleaſure*, and wallow in all manner of *Luxury*.

III. *Who are to be honoured in a Commonwealth.*

But they who lay out themſelves for the *Service*, *Honour* and *Advantage* of the *Commonwealth*, ought to be had in high eſteem by all the Members of it, whoſe *Duty* it is to promote as far as in them lies, all their good endeavours, and to take heed leſt being moved by *Envy*, they deſpiſe the things they underſtand not, or which they themſelves deſpair of attaining to. For what can be imagined more unjuſt, than to think ill of them, who are of uſe to their *Country*, and to hate thoſe who lay out themſelves in doing good to others, and make it their *Buſineſs* to promote the publick *Good*?

IV. *We are freely to give thoſe things, the beſtowing whereof is no detriment.*

The *things* that we may beſtow upon others are, ſuch eſpecially as we can part with, without any damage or prejudice to our ſelves, but are of great advantage to the *Receiver*. And accordingly the *Law* ſaith, *whatſoever is of advantage to me, and is not at all hurtful to thee, the ſame it is not fitting that thou ſhouldſt hinder me of; for this is the Dictate of Equity, tho' it be no due of Juſtice.* It is a piece of a *Malicious Nature* in any one, to forbid others to draw *Water at his Well* ſtanding by the way ſide; or to envy others that are in *darkneſs* to enjoy the *light* of his *Candle*; or who will not permit his *Neighbour* to kindle a ſtick of *Wood* in his *Fire*; foraſmuch as all this may be done without dimminiſhing of the *Water* in the *Fountain*, the *Light* in the *Candle*, or the *Fire* on the *Hearth*. Wherefore, when any one undervalues the poſſeſſion of any thing belongs to him, and intends to make no further uſe of it, it is not only *inhuman*, but *unjuſt* to deny the ſame to another, and rather ſuffer it to be

ſpoiled,

spoiled, than that it should be of use and advantage to others. Wherefore according to the *Law of Nature*, tho' outward *Laws* be silent, all things that are of no use, belong to the *Poor*, and *Richmen* are bound at the least, to bestow all those things on the *Poor* and *Needy* which they leave off, as likewise the superfluous *Meat* of their *Tables*.

V. *We must be Noble and Generous in the Relieving of our Neighbour.* But forasmuch as this last mentioned, is the least piece of *Humanity* we can express to others, they act more generously, and shew themselves more to be *Men*, who are ready to do good to others, tho' with some detriment or prejudice to themselves. Only we must take care, that these our *Charitable Offices*, be not hurtful to those who *receive* them, and instead of being beneficial to them prove their Bane. Thus it is with good reason, that we refuse putting *Arms* into a *Madmans Hands*, deny one that is Sick of a *Dropsy cold Water*, are importunately troublesome to one that is Sick of a *Lethargy* to hinder him from *Sleep*, and keep Mony from him, who we know will go and *throw it away at Dice*. Because in the bestowing of *Benefits*, we are not so much to mind the Will of those who desire them, as of what use and advantage they will be to them.

VI. *Gifts or Benefits are to be bestow'd freely.* In our bestowings of *Benefits*, there must be no hope of receiving the like in lieu thereof; because Vertuous *Actions* carry their *Reward* along with them, and therefore are to be practised without any respect of gain, or advantage to be reaped from them. Thus we give to *Poor Seamen*, that have been *Shipwrackt*, whose Faces we shall never see again, and relieve and succour the miserable, meerly because they are so, and because it is a Duty of Humanity incumbent upon us, to take Pity on the Calamitous and Miserable. By the same motive, we sometimes bestow our *Benefits* secretly, without making our selves known to those whom we relieve, to comply with their Shamefacedness, and that they may rather seem to find it, than to receive it.

VII. *The Duties of those who receive Favours or Benefits from others.* In the receiving of *Benefits* it is required, that we be thankfully affected towards our *Benefactors*, and express our acknowledgment to them, and how ready we shall be upon occasion to return their kindness with advantage. Not as if it were necessary, that our return should be always of the same value, and estimate with the benefit received, for in many cases it is sufficient if only with a sincere *Will*, and grateful *Mind*, we acknowledge our *Obligation*, and are ready to make a return, tho' it may not be in our power to do it. Tho' indeed where *Men* are able, it is better to express their *Gratitude*, by returning the like good *Offices* and *Benefits*, besides the testifying of our thanks by *words*. For the great use of *Benefits*, is to beget a nearer Union and Love amongst *Men*, and to be an occasion for the exercising of *Benevolence* and *Liberality*. But if any one is unwilling to be engaged to another, he may refuse the offered kindness, or at least so handsomely decline it, as that he that offers it, may not take it ill, that his Good-will or Kindness is slighted.

VIII. *There is no Vice more abominable than is that of Ingratitude.* A *Man* cannot be guilty of a more shameful *Vice*, than that of *Ingratitude*; insomuch that there are no *Nations* so Barbarous, no *Manners* so Savage, but do condemn and detest it. For tho' an unthankful person be not injurious to another, yet is he no less infamous than a *Thief*, a *Murtherer*, or a *Traitor*; seeing that the very *Wild Beasts* themselves, when engaged by our care and kindness, are not wanting to express their thankfulness, not only in acknowledging it by their gestures, but often by defending their *Benefactors* in time of danger. And accordingly the *Law* of *Nature* ordains, *that we never receive any Benefit, but with such an inward Disposition, that the Benefactor may never have any occasion to repent himself of having bestowed it upon us.* The reason of which *Law* is, because if we receive a Benefit with a Disposition contrary to this, there will be no more Kindness to be found amongst *Men*, and all Amicableness will be banisht from amongst them.

IX. *Why we cannot bring an Action against an ungrateful person.* But you'l say, if the abominableness of this Crime be such, why are not ungrateful *Men* impleaded, and why may not an Action be had against them?

To which I answer that the reason is plain, because a *Benefit* is a *free Gift*, and being a *Vertuous Action* must not be omitted, because of the unthankfulness of the *Receiver*. Besides, *Gratitude* cannot be lookt upon as a strict due, because it was not agreed upon contract, tho' there might be some hope of it. Moreover, if an *Action* might be had against an ungrateful *Man*, seeing there be so many of them in the *World*, all *Courts* of *Justice* would not be sufficient to hear or determin them, and the rather because of the manifold Circumstances which alter the *Benefit*, and encrease or diminish it.

CHAP. XXVII.

Of the Laws that are to be observed in Covenants and Contracts.

I. *What a Covenant is, and the Original thereof.* BY the word *Covenant* is meant the Consent, or Agreement of 2 or more to the same thing. And it takes its original from hence, because there are many *Benefits* and Good turns, to the Performance whereof we are obliged by the *Laws* of *Humanity*, which yet cannot be exercised without some Injury to our selves, and therefore it was necessary, that *Covenants* should be entred into, by which every one might demand his own, or require and expect what is anothers, but without his Damage or Prejudice.

II. *Covenants are to be faithfully kept and performed.* It is required in all *Covenants*, that they who enter into them, stand to the Agreements they have made and consented to, and inviolably observe what they have promised. For otherwise, there would be an end of *Human Society*, *Friendship* would be banisht out of the *World*, and miserable *Men* would have no Refuge, whither to betake themselves in their *Calamity*. For what would become of all the good Offices of *Humanity*, and the freedom that is between *Friends*, if *Promises* should be broken, and *Mens Actions* should not agree with their *Words*? Besides, where *Men* are not as good as their *Words*, endless matter is furnisht for *Dissensions*, *Quarrels* and *Contests*, because we cannot break our *Words*, without being *Injurious* to the other party concerned. And accordingly the *Law* hath so ordered it, that *Men* may be forc'd to perform their *Covenants*, and to pay what by their Promise they are obliged to.

We

To Francis Forbes of the
Citty of London Gentleman

This Plate is humble Dedicated by Richard Blome

III. *What a Promiſe is.*

We *Oblige* or *Bind* our ſelves 2 ſeveral ways, *viz.* by *Promiſe* and *Covenant*. A *Promiſe* is the Willing or Spontaneous *Obligation* of a ſingle *perſon* to perform ſomething; whereas a *Compact* or *Covenant*, is that whereby 2 or more do oblige themſelves, to do ſomething or other. A *Promiſe* may be divided into a *Complete*, or *Incomplete Promiſe*. We call that a *Complete Promiſe*, when he who promiſeth any thing to another, is willing to be ſo far obliged, as to give him liberty to force him to perform his Promiſe. An *Incomplete Promiſe*, is that whereby a *Man* promiſeth to perform ſomething, yet without giving the other any Right to compel him to the performance of it. So that they who thus engage themſelves to do any thing, are not ſo much bound by the *Laws* of *Juſtice*, as by thoſe of *Veracity*. Tho' indeed *Generous* and *Vertuous perſons*, without any ſuch annexed *Obligation*, are always ready to perform their *Promiſes*, chooſing rather to ſuffer ſome inconvenience, than not to be as good as their *Word*.

IV. *Conſent is required to a Promiſe.*

It is requiſit to the validity of a *Complete Promiſe*, that the pleading of ones word be *Deliberate* and *Spontaneous*; for ſeeing that he who *promiſeth*, may be forced to be as good as his *Word*; he is inexcuſable if afterwards he ſhould complain of it: Becauſe it was in his Power either to agree to it, or to refuſe his Conſent. Now a *Man* is judged to have conſented, not only by *External Signs*, as by his *Words*, *Handwriting*, *Nod*, or other *motions* of his *Body*; but even by his *Silence*, if other Circumſtances concur; becauſe according to that common Saying, amongſt the *Lawyers*, *He who is ſilent, ſeems to conſent.*

V. *Who are in a condition to give their conſent.*

To the end a *Man* may be in a condition to give his conſent, it is required that he be *in his right Wits*, and in the uſe of his *Reaſon*, ſo as to be able to diſcern, whether the thing in *Queſtion* be accomodate and fit for the end intended, and whether, what he agrees to can be performed by him. Hence it is, that the *Covenants* of *Madmen* and *Fools*, are looked upon as void and invalid; as alſo of *Men* in *drink*, if it be made appear that they were ſo far overcome by it, as not to be throughly ſenſible of what they did. For *Conſent* ſuppoſeth a *clearneſs of Perception*; and he may rather be ſaid to be ſeized or hurried away, than to conſent or agree, who by a precipitant impulſe, without conſideration is driven to the doing of any thing. So that he would be lookt upon as a *Shameleſs* and *Unjuſt Man*, who ſhould go about to compel a *Man* to the *ſtanding* to ſuch alike *Agreement*, which at firſt was entred into by an invalid conſent.

VI. *A miſtake invalidates a Covenant.*

As *Reaſon* aſleep or overwhelmed makes void a *Contract*; ſo *Error* or *Miſtake* doth weaken and invalidate it. For whoſoever promiſeth any thing to *another* upon condition, is not bound to keep his *Word*, in caſe the condition do not follow; becauſe the want thereof makes void the *Obligation*. And if there be a *Miſtake* in the thing, about which the *Covenant* is made, it thereby becomes invalid, not only becauſe of the miſtake that is found in it; but alſo becauſe it is a contravention to the conſtitutions of *Covenants* and *Agreements*. For in order to the *Selling*, *Letting*, or *Exchanging* of any thing, it is neceſſary that the *Buyer*, &c. be fully acquainted with the *Condition* and *Qualities* of the *thing*; foraſmuch as without this knowledge, there can be no full conſent; and accordingly he who is about to buy or hire a thing, if any *faults* therein be diſcovered, may break the *Bargain*, or force the other party to make good the defect, or allow a conſideration for the Damage.

VII. *Agreements are made void by deceit and falſeneſs.*

Covenants are alſo made invalid by *Deceit* or *Malice*, when a *Man* is Circumvented by ſome *fraudulent trick*, and drawn into *Agreement*. Therefore he who by Deceit is drawn in to *Promiſe* ought to another, is not bound to perform the ſame, except of his own Free-will, and without any fraudulent enticement he do agree to it; for then he is bound to ſtand to his *Agreement*, as long as there is no flaw in the *thing*, and that its true value be declared. For otherwiſe the *Covenant* becomes invalid, and it is in the power of him who finds himſelf agrieved, to break the *Agreement*, or to demand a *Compenſation* of the Damage he ſuſtains by it. But if another, who is not concern'd in the matter, about which the *Agreement* is made, do mingle any thing of Deceit with it, neither of the *Parties* agreed being *partakers* with him, then the *Agreement ſtands firm* notwithſtanding. But ſo as it is in the power of him that ſuffers by it, to demand Reparation of the loſs he ſuſtains by his Malice.

VIII. *Fear doth not always break contracts.*

Fear, as it doth not take away the freedom of the *Will*, as hath been ſaid in the 20th *Chapter* of this part; ſo neither doth it diſſolve *Contracts*. The ſuffering or puniſhment that is threatned by the *Sovereign* or *Magiſtrate*, if we will not conſent to ſuch an *Agreement* or *Covenant*, cannot invalidate the ſame, except they ſhould go about by any unjuſt force to compel us to it; becauſe in this caſe the *Injury* they do unto me by the unjuſt fear they caſt me into, makes them incapable of having any *Right* over me. And ſeeing that the Damage cauſed by another, ought to be repaſſed by him, by way of *Compenſation*, that *Obligation* is ſuppoſed to be taken away, if no ſatisfaction be made for the thing, which ought preſently to have been reſtored.

IX. *About what things Agreements may be made.*

As to the nature of the *things* that are agreed upon, or are promiſed, many *things* are required. *Firſt*, that they be ſuch as are in our *Power*; for otherwiſe it would be an Argument of *Madneſs* or *Diſhoneſty*, for a *Man* to *Promiſe* or *Covenant* that which is not in his power to perform. For no *body* is bound to perform *Impoſſibilities*, according to that common Rule, *There can be no Obligation to Impoſſibles*. For tho' at the firſt, when the *Covenant was made* the thing was poſſible, if afterwards by chance, without the fault or neglect of the *party bound*, it be made impoſſible, the *Obligation* is diſſolved, and the *Covenant* becoms void.

X. *They muſt be things lawful or permitted.*

Secondly, they muſt be *things* that are *Lawful*, for otherwiſe we cannot be obliged to the performance of them. For he that promiſeth to give a *Whore* the meeting; or hath paſt his *Word* to *Maim* or *Kill* another, is not bound to keep his *Oath* or *Promiſe*. Becauſe no *Man* can bind himſelf to any thing which it is not in his power to perform: Now the *Laws* have abſolutely depriv'd him of any ſuch power, nor will ſuffer him to execute that, which they plainly prohibit. So that if he be guilty, who promiſes that which the

Law forbids, he is doubly so, who having Promis'd such things, does stand to his *word*.

XI. *They must be such as we have a Right to.* *Thirdly*, They must be *Our things*, that is, we must have a Right and Propriety to them; because we cannot Promise any thing which belongs to another. But in case we have Promised to take care, that what we have Promised shall be performed by another, over whom we have no *Command*; we are bound to use our utmost Diligence, and to omit nothing (as far as in a Civil way we can) that he may make good what we have so Promised.

XII. *Promises are made two several ways.* A *Promise* may be made 2 several ways, either *Absolutely*, or *upon Condition*. Now a *Condition* may be 2 ways consider'd, either as *Possible* or *Impossible*. An *Impossible Condition* is either taken *Physically* or *Morally*. A Condition is *Physically Impossible*, when considering the Nature and Order of Things, the Matter cannot be done; and *Morally Impossible*, when they are forbidden by *Law*, or contrary to the Laws of *Honesty*. And these *Promises* are either made by *our selves*, or by some Intervening Persons; which we likewise are bound to perform, in case they have carried themselves honestly and faithfully, and have done nothing, but according to our Order.

CHAP. XXVIII.

Of Special Compacts or Agreements.

I. *What a Contract is* THo' a *Covenant* and *Contract* be often confounded by *Authors*, and include, as ULPIANUS saith, the *Consent* or *Agreement* of two or more *Persons*; yet to speak more exactly, a *Contract* seems chiefly to consist in an Interchangable giving and receiving; or to be chiefly conversant about things of *Commerce*.

II. *Of Contracts Nominate and Innominate.* Of *Contracts*, some are called *Nominate*, as *Selling*, *Buying*, *Lending*, *Letting*, *Pawning*, *&c.* which have a particular Name whereby they are distinguisht from others. Others *Innominate*, that have no particular Name belonging to them, but are only signified by the common Name of *Contracts*. And these are reducible to 4 kinds: *I give that thou mayst give; I give that thou mayst do: I do that thou mayst give; and I do that thou mayst do.* In all which *Contracts*, an *Action* is allowed in any Form of *words*, when a certain one cannot be assigned: For we find by Experience, that there is a greater plenty of *Business* or *Affairs*, than of *Words*.

III. *Some are Gratuitous, others Burthensom.* *Secondly*, *Contracts* are divided into *Lucrative*, otherwise called *Gratuitous*, that is, such by which *Profit* accrues to one of the Parties concerned, without the Intervening of a *Merchandize* or *Price*: And *Burthensom* or Chargeable, in which both *Parties* have an Equal burthen charg'd upon them, and in which there is a kind of *Recompensation*. For it is the property of all *burthensom* and *chargeable Contracts*, that the Parties concern'd in it, have an equal Advantage by it, and undergo a like *Burthen*. Insomuch as if it otherwise happen, the Party who finds himself frustrated, hath Right to demand what is wanting to him, or else to break the *Contract*. And accordingly, it is usual in *well-governed Cities*, to have the *prizes* of every thing set and stated, to prevent all common Abuses in such cases.

IV. *Gratuitous, or Lucrative Contracts are Lending.* *Gratuitous*, or *Lucrative Contracts*, are commonly reduc'd to these three; a *Loan*, a *Commission* or Charge, and a *Depositum* or Trust. A *Loan* is, when the use of a thing is granted to another, without any recompence therefore received or appointed. It is his concern who borrows any thing, that he be very careful of the thing that is Lent him, that it may not be put to any other use, than what is prescrib'd by the *Lender*; and accordingly is oblig'd to restore the same whole and found; excepting so much only as it may be the worse for so long using. If the thing Lent, whilst it is yet in the custody of him that hath *borrowed* it, come to be lost or spoil'd, the Value of it must be restor'd by the *Borrower* to the *Owner*: But if it be of such a Nature, that it could not have been better kept, if it had been in the *Owners* keeping, the *Borrower* is not bound to make it good. Yea, if it so happen that the *Borrower* hath laid out any thing towards the mending or improvement of it, it is but Just that the *Owner* should repay it, besides those *Expences* which always attend the ordinary use of any thing.

V. *A Charge or Command.* A *Charge* is, when a Man takes upon him to perform a *Commission* he is charg'd with, without any hope of *Reward*. And he who undertakes any such Charge at the Instance of another, or of his own accord, must take care to be punctual in performance thereof. For seeing that no Body trusts his Affairs, but with a Friend of whose *Faithfulness* he is assured, the *Undertaker* ought to be very Solicitous to shew himself an honest and true Man, and that in all things he answer the Expectation of his *Friend*, and the Confidence he puts in him. Now he who undertakes any *Command* or *Charge*, must be allow'd for all the Expences or Damages that may be in the Executing of the said *Commands*.

VI. *A Pledge or Trust.* A *Trust* is a *Contract*, whereby something is entrusted with another to be kept. The Person with whom the thing is entrusted, is called the *Depository*; who is to take great care, that the thing he is entrusted with, be not lost or spoil'd, and that he be always ready, at the Will of the *Depositor*, to restore it. Except it should be more for his Advantage to want it for some time, and that it be found better; because of some imminent Danger, to defer the restitution of it till a later date. But yet the *Depository* may not make use of the same, except with the *Owners permission*; if either it be such a thing as grows the worse for using; or if it be the *Owners* Concern that it be hid, and be not exposed to the Sight of others.

VII. *Burthensom or Chargeable Contracts, are Permutation.* The most Ancient of all *Chargeable Contracts*, and received by all Nations, is *Permutation* or *Exchange*, used before *Mony* was Coyn'd, to be the indifferent Price of all things. The Formality whereof is prescribed §. *Item pretium de Empt. & Vendit*: *I willingly graunt you the thing you desire of me upon this Condition, that you likewise do graunt me another thing which I ask of you, according to the tacit Estimation of both the things made by our selves.* Opposit to this *Contract* is *Donation*, whereby a thing without any Compulsion of the *Law*, and out of meer Benevolence and Good-will is bestowed upon another; forasmuch as it is not necessary that any Equality should be observed therein.

To

VIII. *Buying and Selling.* To *Permutation* belongs also *Buying* and *Selling*, whereby a thing is either purchased or let go for a *Price:* For by the former there lies an Obligation on the *Buyer*, to deliver the *Price* agreed on for the *Commodity*; as by the latter, the *Seller* is bound to let go the *Commodity* for the *Price*. Which is done many ways: As *First*, When there is a mutual *Agreement*, and the *Buyer* immediately offers his *Mony*, and the *Seller* his *Merchandize*. *Secondly*, When tho' the *Merchandize* be immediately deliver'd, the *Price* is not to be paid till such a set time after. *Thirdly*, When after that the *Parties* are Agreed about the *price*, the *Merchandize* is not to be deliver'd till a certain Time. In which last *Contract*, it is consentaneous both to *Reason* and *Justice*, that if the thing should come to be lost or spoil'd before the prefixed time, the *Seller* should bear the loss of it. But if after that time expired, the *Buyer* neglect the taking of the *Commodity*, if any damage happen to it, it must be at his Loss.

IX. *Letting and Hiring*, are near of Kin to *Buying* and *Selling*, whereby, for an appointed Price, the use or worth of a thing is granted. I said, for an appointed *Price:* For if (saith JUSTINIAN, *Inst. l.* 3. *Titul.* 25.) I give a *Fuller* Cloth to be dressed, or to a *Botcher* Cloaths to be mended, without the appointment of a Set price; but only that afterwards I shall give as much as shall be agreed upon between us; this Contract cannot be called *Letting* or *Hiring*, but allows an *Action* set down in a precise Form of *Words*.

X. *What is to be observ'd in Hiring.* About this *Contract* it is to be observed, that if in the Time of *Hiring* the thing be spoiled or perish, he who hires it, is not bound to pay the *Price* of it. In like manner, when a thing design'd to a certain *use*, which the *Owner* is bound to deliver safe and sound, does chance to suffer any loss or detriment, whereby it is made less proper for the use it is appropriated to: He who *Hires* it, may with Justice detract so much from the *Price* of it, as it is become less fit for its intended use; tho' this cannot be where the increase or incom of the thing is uncertain. As for Example, If a Man have *hired* a *Field*, whose *Fruits* have been spoiled by the Unseasonableness of the *Weather*; he is bound notwithstanding to pay the *Hire* he hath agreed for, tho' the Incom he has from it, for that *Year*, be little or nothing: For as a plentiful Incom doth not increase the *Hire*, neither doth it seem Equal, that a scarce Increase should diminish it; since it frequently happens, that one *Years* Barrenness, is compensated by the Fruitfulness of the next following.

XI. *Things lent.* *Lending* is a *Contract*, whereby a Man delivers something of his *Goods* to another, upon Condition that he, after some Space of Time, do restore to him as much of the same kind and goodness. *Things lent*, are such as are spent or consumed by *using*, and do consist in Number, as *Mony*; in Weight, as *Gold*, *Silver*, *&c.* in Measure, as *Wine*, *Oil*, *&c.* The *Gospel Law* Commands us to *lend*, without expecting any Gain or Advantage to our selves there from: Which *Law* is transgrest by the *Usurer*, who tho' he be bound to relieve the Wants of his *Neighbour*, doth by *Usury* gain thereby, and enriches himself out of the miserable Remains of *Shipwrack*, by an unnatural Cruelty to those of his own kind. I am not ignorant of the *Distinction* the *Lawyers* make here, of the *Ceasing Gain* and *Emergent Damage*. And indeed his Case is different, who *lends Mony* to one that desires it, not to deliver himself from his present Necessities, but that he may Negotiate therewith, and make a great advance of Gain to himself from the *Mony* he hath borrowed; and of him, who being shut up in a *Prison*, and miserably *Poor* and oppress't by a Cruel *Creditor*, desires to borrow a Sum of *Mony*: For in this case, what he desires ought either to be given to him freely, out of Pity to his Condition, or at least be *lent* to him, without demand of *Use* for it.

XII. *The Conditions of the Contract of a Society.* There is also another sort of *Contract*, which is called a *Society Contract*, or a *Partnership*, and is the Agreement of 2 or more *Persons*, whereby something proper to make Gain with (as *Mony*, *Work*, *Industry*) is contributed in order to a Common Use or Advantage. Now, to the end that such a *Society* or *Partnership* may be Just, 3 things chiefly are required: *First*, That the *Trade* or *Dealing* they intend be Just and Lawful; for no Man can be bound to that which is Unlawful. *Secondly*, That their Shares in *Gain* and *Loss*, be equally proportion'd to the Shares of the *Stock* laid in by the several *Members* of the *Partnership*; so as that his *Gain* may be greater that hath a greater Share in the *Stock*, as his less that hath a less; because by this means every ones Due is given to him. *Thirdly*, That the Loss in like manner be Common, and be equally divided amongst the *Partners*; tho' sometimes the *Contract* be so, that one contributes *Mony*, and another his *Work* or *Labour* only; which frequently is Equivalent to *Mony*. Wherefore the Origial *Contract* is to be heeded, and how the *Parties* are agreed about their Shares of *Loss* and *Gain*.

CHAP. XXIX.

How many ways the Obligation, arising from Covenants, may be dissolved.

I. *How Obligation may be taken away, by Solution or Payment.* SEeing that *Obligation* is a kind of Tye or Engagement laid upon us by *Law*, whereby, as JUSTINIAN saith, We are of Necessity bound to pay some thing, according to the Laws of the *Society* we live in, the same is readily and Naturally taken away by *paying* or *satisfying* of the same. For thereby the *Duties* thence arising cease, as also the *Action* whereby a Man before was Bound. To the end this *Payment* may be duly made, it is not necessary that it be done by the *Debtor* himself, but it is sufficient if it be done by *another*, in his Name. For a *Debtor* is quitted of his *Obligation*, if the *Mony* be paid by another, tho' without the Knowledge, and contrary to the Will of the *Debtor*. Neither is it necessary always to *pay* the *Debt* to the *Creditor*; but it is sufficient if it be paid to any one appointed by him.

II. *By Donation.* *Secondly*, An *Obligation* is dissolved by *Donation*, that is, by *Remission*, or Forgiving of the *Debt*; which is commonly done either by *Acceptilation* or *Imaginary Payment*, with the use of some Signs intimating a Consent or Agreement, which of old was in use amongst the *Greeks*; the *Debtor* speaking these Words, *You have received so much Mony:* To which the *Creditor* delivering his *Bond* or *Note*, answer'd, *I have received them.*

Thirdly,

III. *By Compensation.* *Thirdly*, *Obligations* are taken away by *Compensation*; as when the *Creditor* by a former Engagement was a *Debtor* to his *Debtor*, owing him something of the same kind and value. For in things deliver'd for use, an *Equivalent* is reckon'd as the same thing. Hence it is, that in *Actions* at *Law* of this kind, *Compensation* was always allow'd of; *viz.* an *Exception*, whereby any Man rids himself of his *Creditor*, by shewing that he is his *Debtor*; for a *Debt* is Compensated with a *Debt*, *Fraud* with *Fraud*, and a *Fault* with a *Fault*, and this very very Justly too, saith the *Law*; for we are rather not to *pay*, than to redemand what we have *paid*.

IV. *By a contrary Will.* In the *Fourth* place, *Obligations* that are entred into by *Consent* or *Agreement*, are dissolved by a *contrary Will*: For suppose TITIUS and SEJUS have agreed together, that SEJUS should have a piece of *Ground* for 100 Pieces of *Gold*; and that before the *Mony* be paid down, or the *Land* delivered, they should agree together to break their *Contract*; it is evident, that by this means that *Contract* would be dissolved. And this is common to all *Contracts*, which are made and ratified by *Agreement* and *Consent*, especially that of *Partnership*, which continues only so long as the *Parties* abide in the same Mind.

V. *By the intervening of a New Agreement* *Obligations* also are dissolved by the Intervening of a New *Obligation*, as if the *Debt* which *John* owes me, should by Agreement be made payable to me by *Paul*; because this intervening of a new *Person*, makes a new *Obligation* to take place, and annuls the former. Neither is it necessary, that this latter *Agreement* be advantageous; for tho' it were quite otherwise, yet would it notwithstanding make void the former.

VI. *By urgent Necessity* An *Obligation* is likewise made void by *urgent Necessity*; and therefore a *Debtor* that is reduc'd to extream Want, is not bound to pay his *Creditor*, tho labouring under the same Extremity of Want; because in Extream Necessity all things are common, and the Condition of him who is in Possession is accounted the better of the two.

VII. *By breach of Word or Articles.* He that breaks his *Promise*, and doth not perform his *Articles*, doth rather break off the *Obligation*, than make it to cease. For seeing that all *Contracts* are mutual, and that the *Parties* are equally bound to perform what they have agreed to, when one breaks his *word*, there is an end of the *Contract*: For the Pledging of our *Faithfulness*, supposeth the Faithfulness of the other party, and is as a Condition in reference to the other. I shall perform what you require of me, if you do first what I require of you; and I will stand to my *Promise*, as long as you inviolably observe the *Agreement* we have made.

VIII. *By Death.* *Lastly*, An *Obligation* is annull'd by *Death*, and any *Contract* ceaseth, when it rests only upon one *Person*, whereas the *Agreement* was made by two. For where the Subject is destroy'd, the Accidents which do attend it, must of needs perish likewise. Except that the *Heir* of the deceased Party, of his own inclination, or out of his respect to the Deceased, do take upon him to satisfie the said *Obligation*: Or, if by the Last *Will* of the *Dead*, he be bound to pay the *Debts* of the *Deceased* out of his *Estate*, and that he is made his *Heir* upon that Condition.

CHAP. XXX.

Of the Laws that concern Speaking and and Swearing.

I. *Deceitfulness in Speech is to be avoided.* FOrasmuch as *Covenants* and *Contracts* are performed by *Words*, and that it is necessary for the maintaining of *Human Society*, that *mens Minds* be made known by *Speech*, we shall add something here concerning the *Duties* to be observed in *Speaking* in general, and afterwards of those that are to be heeded in *Swearing*. The first thing to be observed in *Speech* is, that we do not deceive any one by our *Words*, or by other *Signs* used instead of them, for the expressing of the Sense of our *Minds*. For the Truth of our *Speech* or *Words* must be constant and inviolable, after the same manner as we find that amongst *Animals*, some outward *Species* do remain, whereby they discern things Friendly or Inimical to them.

II. *Conditions to be observed in Speech.* To the end the Præscript of this *Natural Law* may be the better understood, we are to take Notice, that a double *Obligation* lies upon those that speak, with Relation to their *Words* or *Speech*. *First*, That those who use the same *Speech* or *Language*, do make use of certain and determinate *Words*, to signifie such certain and determinate *Things*, according to the use of the *Language* that is received in the *Country* or *City* where a Man lives. For it is not lawful for any one, at his own pleasure, to Coin new *Words*, but must make use of those, which have been long approv'd of by Use and Custom, and signifie things according as they are taken and understood by all. *Secondly*, That every one do so open his *Mind* to another, as clearly to manifest what he intends, and so as that the same may be clearly apprehended by him he speaks to. This *Obligation* may arise, either from a particular *Agreement* a Man hath made with another, to discover unto him what he knows about such a business. As when one Agrees with one that is *Master* of any *Art*, to be taught the same by him: Or, from the Precept of the *Common Law* of *Nature*, whereby a Man is bound to impart his *Science* to another; either for his Profit and Advantage, or to prevent some *Evil* that threatens him: Or, when by *Law*, whether Perfect or Imperfect, a *man* is bound to discover those things, concerning which he is Interrogated.

III. *When we may dissemble our Thoughts.* But if those to whom we *speak* be of such a Temper, that an open and simple Declaration may be prejudicial to them, or that it may give them occasion of hindring and opposing what we are about; it may be lawful for us to dissemble our *Minds* at that time, and to palliate our Intentions. For though it be our Duty to do good to others, yet are we not bound to do it, when we have good Reason to believe, that in so doing we shall be croſt in the thing we intend. Neither is this to be call'd *Lying*; for tho' our *Words* do not exactly represent the Sense of our *Mind*, yet do they not of set purpose carry another Sense, than our meaning really is; nor hath he to whom we direct our *Speech*, any Right to understand or know them: Neither are we bound by any means to cause him to apprehend our Intentions. For it is frequently Expedient in *Human Society*, that the *Truth* should be hid, and that the thing which is about to be undertaken, should be kept from the Knowledge of many.

From

IV. *Fiction is no Lie.*

From what hath been ſaid, may be gathered, that he is not to be lookt upon as a *Lyar*, who at *play*, by ſet *Words* and *Geſtures*, endeavours to conceal his Intentions, to deceive the party he *plays* with, and to inveigle him to do that whereby he may loſe the *game*. Nor he, who by *feigned Stories* and *Fables* deceives the *Minds* of *Children*, who are not yet capable of down-right *Truth*, with a deſign to excite them to the *Love* of *Vertue* and the *Hatred* of *Vice*. Nor he who impoſes upon an *Angry Perſon*, comforts one that is *ſorrowful*, or by colour'd *Speeches* perſuades a ſick perſon, that the *Medicin* he is to take is very grateful and pleaſant. Becauſe none of theſe are done with a deſign to deceive or wrong, but on the contrary, to do them good, and to eaſe them of that *Paſſion* which afflicts them. But the caſe is quite different where a man is bound to declare his *Mind* to another; becauſe by uſing doubtful *Speeches*, or diſcovering only one part of the *Truth*, he becomes unfaithful, and ſins againſt the *Rules* of *Juſtice*.

V. *What an Oath is.*

Our *Speech* is capable of being ratified and confirmed by an *Oath*. For an *Oath* is the calling of *GOD* to witneſs to the *Truth* of what we do aſſert: Or as others will have it, *It is a Religious Act, whereby we call upon GOD as the Supream Truth, in witneſs to a thing, that is not ſufficiently known to others.* And accordingly the very *Heathens* themſelves knew of no ſtronger tie whereby to engage to be faithful and to ſpeak the *Truth*, than that of an *Oath*. For they who take an *Oath*, do bind themſelves by the Aw and Reverence they have for *GOD*, to be as good as their *Word*, and to ſtand to their *Covenants*. And forasmuch as they own that *GOD*, whom they *worſhip*, to be Omnipotent and Omniſcient, it is to be believed, that no *Man* is found ſo wicked, as to dare to provoke his Indignation, and to engage his Revenge. Wherefore he alſo who *ſwears* by falſe *gods*, ſuppoſing them to be true, is bound to perform what he hath *ſworn*, and if he breaks his word, he is Perjur'd.

VI. *Three kinds of Oaths.*

An *Oath* is either *Aſſertory*, when we make uſe of it to confirm an Aſſertion about a thing preſent or paſt; when no better way is found to diſcover the *Truth*. And ſuch an *Oath* as this is required of *Witneſſes* before a *Judge*, or from others, who ſome other way have any knowledge of the *Fact*. There is another *Oath*, which is called *Promiſſory*, when one by *Oath promiſes* any thing to another, and binds himſelf to the performance thereof. And laſtly, there is another *Oath* of *Deciſion*, where 2 are that are in conteſt together, and preſenting themſelves before the *Judge*, one of them by taking an *Oath*, doth decide the matter in conteſt.

VII. *Of the Conditions to be obſerved in every Oath.*

That there may be an *Obligation* upon a *Man*, to keep his *Oath*, it is requiſit, *Firſt*, That he know the thing to be *true or falſe*, which he aſſerts or denies by *Oath*; or whilſt he *ſpeaks*, according to what he thinks, and is perſuaded thereof, whether it be ſo or not. For he that *ſwears* to any thing which he judges to be ſo, his *Oath* cannot be blamed, becauſe he ſpeaks according to what he thinks and is perſuaded. *Secondly*, It is requiſit that he take his *Oath* Seriouſly and with mature Deliberation. And therefore he who repeats the *words* of an *Oath* to another, is not bound thereby; but he that ſpeaks them *ſeriouſly*, and with the poſture and formality of thoſe that take *Oaths*, tho' it may be, he intends nothing leſs in his *Mind*, than to be true and faithful to what he *ſwears*.

VIII. *We muſt not ſwear contrary to our Conſcience.*

Wherefore I cannot aſſent to their *Opinion*, who ſuppoſe that a *Man* who is brought before a *Judge*, about a Debt of 100 pieces of *Gold* which he owes to another, may *ſwear* falſly, in caſe he knows that the payment of that *Mony* ſhould caſt him into extream Difficulties. For they ſeem to ſuppoſe, that *GOD*, the Sovereign of *Truth*, may be produced as the witneſs to a *Lye*; as if he did not behold, and in due time would *Judge* and Revenge thoſe, who, in ſo daring a *manner*, do affront his *Majeſty*. For what elſe is it to deny a juſt *Debt*, but to deny *GOD* to be Juſt and Equal, and to promiſe impunity to *perjured Perſons*? For if it be lawful for a *Man* to forſwear himſelf, and to think one thing, and ſpeak another, the validity and reverence of *Oaths*, and of all *Covenants* and *Contracts* will be baniſht from the Societies of *Men*, and nothing but *Fraud*, *Deceit* and *Iniquity* will be found in all their agreements and dealings together.

IX. *What is to be conſidered in him that ſwears or takes an Oath.*

Yet muſt not every *Oath* be taken for ſuch, except that we be aſſured that it hath all the *Conditions* requiſit to a Valid and Lawful *Oath*, and which ought to be rigorouſly, and not perfunctorily examined. For he, who out of *hatred ſwears* againſt another; or he, who being terrified by the *Threats* of an *Enemy*, doth confirm his *Promiſe* with an *Oath*, is ſuppoſed not to have *ſworn* at all, ſeeing that he never did it with any voluntary Deliberation, but being hurried on by fear and Paſſion only. In like manner he, who promiſeth ſomewhat to another indeterminately, and confirms his *Promiſe* with an *Oath*, is not bound thereby to grant to another what is diſhoneſt, abſurd or hurtful; becauſe it is ſuppoſed, that he who hath made the demand is led by reaſon, and conſequently would not deſire any thing that is morally impoſſible or unjuſt.

CHAP. XXXI.

Of Dominion, and the Duties thence ariſing.

I. *The State and Condition of the Firſt Men.*

NOthing is more celebrated in the *Writings* of the *Antient Poets*, than their ſtate of the Firſt *Men* in the *World*.

The Golden Age was firſt, which uncompel'd,
And without Rule, in Faith and Truth excel'd.
As then there was nor Puniſhment, nor Fear;
Nor Threatning Laws in Braſs, preſcribed were.
Nor ſuppliant Crouching Pris'ners ſhook to ſee
Their Angry Judge; but all was ſafe and free.

For they tell us, that at that time all things were common, and that the Terms of *Mine* and *Thine*, now too familiar, were not known. So as that the care and thoughts of all *Men* conſpir'd only for the good of the *Publick*, and every one neglecting his own particular concerns, was only ſollicitous for the Intereſt and Welfare of the whole *Society*. But whatſoever they may talk of this Community, it appears, that from the Beginning of the *World*,

things were accounted, as of right, belonging to him who was the first *Occupant*, and that every one did challenge that to be his own, which by his *Labour*, *Industry*, or Good *Fortune* he had got possession of. As it is evident in *Abel* and *Cain*; who, tho' they were *Brethren*, yet had each of them their distinct *Families* and distinct *Possessions*: for how else could they have offered a *Sacrifice* to *GOD*? Or how could that which was offered in common by them, be accepted and rejected? Wherefore we must conclude, that every one by an instinct of Nature, out of the *love* he bears to himself doth affect the Possession of *Goods*, and is ambitious of a Lordship or Dominion over other things.

II. *What Dominion is.* *Dominion is the Power or Right which a man hath over a thing, to dispose of it, as of a substance belonging to him.* Whence it is that a Possessor or Owner, can dispose of the things that are his, as it best pleaseth him, by *giving them away*, *Exchanging* or *Selling* them, and hindring any one else from making use of them, except they be such things as are proper to many, and belong to the *City*, or some other *Society*.

III. *Dominion is acquired originally by occupation of what never belonged to any.* There are 2 General ways of acquiring *Dominion*, viz. *Originally* and *Derivatively*. By the former of those ways we acquire the *Dominon* of a thing by *Occupation*, when it did not belong to any one before, but was by the profuse Bounty of Nature exposed to the first *Occupant*, or him who first challengeth it for his own. For seeing that all things, at the Beginning, were produced for the *Good* of *Men*, and therefore may fall under their Dominion, it was ordered by a just Right, that things should be his who first claimed them, and that he should safely enjoy them, who had got them into his possession before all others. Wherefore, because under this name of *Occupation*, are understood *Fowling*, *Hunting* and *Fishing*; the *Birds* of the *Air*, the *Beasts* of the *Earth* and *Fishes* of the *Sea*, according to the *Law* of *Nations*, begin of right to belong to him who first takes them. For *what before belonged to no man, that by Natural Right becomes his who first occupies or seizeth it*, *Justinian Inst. l. 2. de Rer. Divis.*

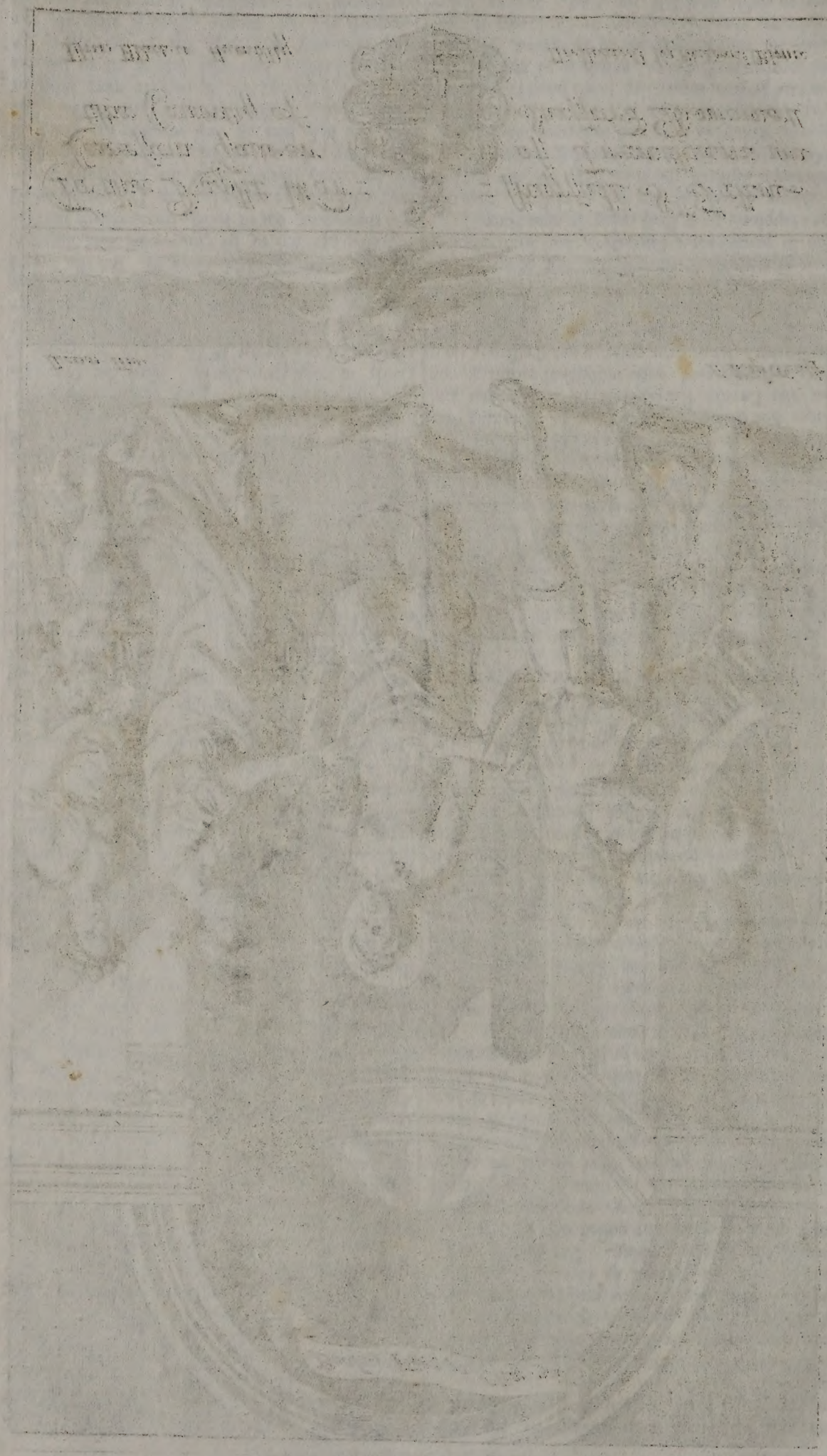
IV. *By Occupation of what the Owner hath relinquisht.* Things also may be acquired by *Occupation*, if they be derelinquisht by the *Lord* or *Owner*, with the design of never esteeming them for his own any more, and consequently ceaseth to be *Lord* over them. But the case is not the same in things which during a storm, are cast into the *Sea*, with a design to lighten the *Ship*; for these do still continue to be the owners; because it is manifest that he did not cast them *overboard*, because he had a mind to be rid of them; but that by the casting of them into the *Sea* he might save the *Ship*, and consequently his *Life*.

V. *Dominion is by several ways Derivatively acquired.* The second way of acquiring *Dominion* is, either by *Tradition* or Delivery, as when a thing passeth from one to another. For nothing is more conformable to Natural Equity, than that his *Will* should stand, who has a mind to translate the *Dominion* of a thing that belongs to him, to another. And therefore of whatsoever nature a *corporal thing* may be, as the *Lawyers* say, it may be passed over to another, and being thus past over by the *Lord* or *Owner*, it thereby becomes alienated. Or by *Emption* or *Purchase*; and things so acquired, by paying unto the *Seller* the sum agreed upon, or satisfying him some other way, as by Promise or giving him a *Pledge*. Or by a *bare signification of ones Will*; as if a man who hath lent, let, or deposited any thing with me, should afterwards sell me the same, or bestow it upon me: for in that he suffers it to be *mine*, I immediately acquire a right to it, as effectually as if he had by deed past it over to me. Or by *Succession*, as when a *Man dies* Intestate, for then all his *Goods* are devolved to his next *Heirs*. For it is agreeable to Reason, and conducive to the *Peace* of *Human Society*, that what a *Man* hath in his *Life-time* acquired by his *Labour* and *Industry*, should not be lookt upon as things derelinquisht, and so left to the first Seiser, but that they should be the *Heirs* of him who dies *Intestate*, that are neerest in *Blood* to him.

VI. *By long Possession or Prescription.* There is also another way of acquiring *Dominion* by *long Possession* or *Prescription*; when a *Man* hath honestly acquired a thing, and hath possest the same without Interruption, the Term of time set by the *Law*. Because according to the *Law* of *Nations*, that is lookt upon as relinquisht and forsaken, which for so long a time hath not been challenged by any *Man*. And therefore after the Term appointed by the *Law* is expired, he who is in Possession is not bound to restore the thing he hath been so long possest of; but the *Dominion* or *Propriety* thereof is devolved upon him, and he may lawfully keep the same, not only in the outward *Court*, but also in the *Court* of *Conscience*, because the *Sovereign Magistrate* is supposed to have Power for the Publick Good to enact, that after a long continued Possession, the *Goods* of one *Man* should be transferred to another, lest continuing so long doubtful, it should perpetually give occasion to fresh suits at Law.

VII. *The first Law that is to be observed after Dominion acquired.* The following *Laws* seem to have taken their Rise from the acquiring *Dominion* of *Corporal things*. The *First* whereof is, *that no body disturb the Possession of another, but that he suffer him with Peace and Quietness to enjoy his acquired Goods: so as not fraudulently to be the cause of any detriment or damage to him, or by any way contribute to the taking of them away from him.* By which *Law*, *Theft*, *Rapin* and other unjust *Substractions* of Goods are forbid. So that not only the violent taking away of another mans *Goods* must be avoided, but also those which are clandestine, and the Owner is ignorant of.

VIII. *The Second Law.* *Secondly, If the Goods of another be honestly fallen into our hands, without any fault of ours, we are to do our Endeavours to find out the true Lord and Owner of them, that they may be sent back to him, as soon as he shall be known to us. But yet there is no obligation upon us, to restore the same at our own Cost and Charges; but we may justly demand the Charges we have been at in keeping or restoring the same, and keep the Goods till the same be repaid us.* But as to those things which we have honestly purchased, and have a clear *Title* to, these we are not bound to call in question before him, and, as it were, make known to all, whether he will account it amongst things that are lost; because we are assured of the *Equity* of the *Contract* or *Bargain* whereby they are become ours. Yet when we have certain knowledge, that any stolen *Goods*, have been deposited with



To the Right Wor= =shipfull Sr John
Leveson Gower of Trentham in
the County of Stafford Baronet

This Plate is humbly Dedicated by Richard Blome

with us, without our knowledge, we are bound to reſtore the ſame, not to the *Thief*, but to the true Owner.

IX. *The Third Law.* *Thirdly, If we have ſpent any Goods belonging to another, which we honeſtly came by, then only the Obligation lies upon us, of reſtoring ſo much to the Owner, as we have profited thereby; and if we have not profited by them, neither are we bound to reſtore any thing.* The *Reaſon* is, becauſe he who is honeſtly poſſeſt of a thing, is not bound to reſtore the *thing*, upon the account of any unjuſt coming by it, ſince he both came by it and ſpent it honeſtly. Nor by reaſon of the meer *receiving* it, ſeeing that no more of it is left. Only he is bound to make reſtitution, if he be grown more *Rich* by it, that is, if thereby he have ſpared thoſe charges which otherwiſe he would have been neceſſitated to; or have ſomething, which otherwiſe he could not have.

X. *The Fourth Law.* *Fourthly, If any thing that belongs to another be acquired by a chargeable Title, it is the duty of the Poſſeſſor, to reſtore the ſame to its true Lord; neither hath he any Right, to demand of the Owner, the Mony he hath laid out for the Purchaſe of it; but can only demand it of him, from whom he hath purchaſed the thing.* Except it be made appear, that in all probability the *Owner* could never have recovered his *Goods* without being at ſome Charges, or that he hath of his own accord promiſed a reward to him, that ſhould find them, or tell him news of them.

CHAP. XXXII.

Of the Duties of Married Perſons.

I. *Why Matrimony was inſtituted at firſt.* THE firſt *Divine Inſtitution* appointed for the *Good* of *Man*, was that of *Matrimony*, which accordingly hath been celebrated and eſteemed in all *Nations*. For the order of Nature, and the neceſſity of Life do require, that *Men* ſhould by *Propagation* preſerve their *kind*; and by a continual *Succeſſion* ſecure *Mankind* from utter periſhing. Hence it is that *Men* take to themſelves *Conjugal Companions*, and by means of the ſaid meet-helps, at once provide for their Poſterity and Welfare. For ſeeing that *Matrimony* is nothing elſe but the Lawful *Conjunction* of a *Husband* and *Wife*, accompanied with individual intimacy and familiarity; whoſoever enter upon the ſame, do it with intention of paſſing the whole courſe of their *lives* ſweetly and pleaſantly, by means of this mutual conſent of *Souls* and *Bodies*: foraſmuch as they would never deſire it, but out of an inclination to propagate a Succeſſion, and from hope of the Happineſs they ſhall enjoy in that State.

II. *All Impurity and Filthineſs is contrary to Nature.* About *Matrimony* we are to obſerve, that this vehement *deſire* of the *other Sex*, was not put into *Man* by GOD, for the ſatisfying of his *voluptuouſneſs*, which is baſe and infamous, and always drags *Repentance* after it; but to the end that *married perſons* might live more happily together, and propagate *Poſterity*, which is of abſolute neceſſity for the continuation of *Mankind*. Whence it follows, that it is contrary to the intent of *Nature* to defile ones ſelf by *Luſt*, and to deſire any other pleaſures, but what the *Nuptial Bed* affords.

Foraſmuch as *Man* is placed in this *World*, not as an abſolute *Lord*, but only with permiſſion to uſe and enjoy the things that are in it, without deſtroying or hurting the ſubſtance of them; an *Obligation* ſeems to lie upon him, to enter upon *Marriage*, that he may render to *Nature*, what he hath received from her, by begetting *Childring* to ſupply the room of his *Parents* and *Anceſtors*. For *Human Society* cannot, without great inconvenience, permit the Propagation of *Human kind* any other way than by lawful *Marriage*; all other promiſcuous and wandring *Luſts* being condemned, and puniſht by it, whereby either an unjuſt *Heir* is clapt upon an *Eſtate*, or a *Virgin* is vitiated. Yet is not every one therefore bound to *Marry*; ſeeing that the Nature of ſome is repugnant to it, and the habit and conſtitution of their *Body* does not comport therewith. But thoſe only who cannot well live without a *Wife*, or who think they ſhall be more uſeful Members of the *Commonwealth*, by *marrying*, than if they ſhould continue in a ſingle ſtate.

III. *There is a kind of obligation upon Man to enter upon Matrimony.*

They who are *married* muſt ſtedfaſtly reſolve never to break the *Conjugal Bond*, by any unlawful *Luſt*; for by means of the ſaid *Marriage* knot, the *Husband* belongs to his *Wife*, and the *Wife* to her *Husband*: ſo that he who ſeparates them, ought to be lookt upon no better than a *Murtherer*, and to be as ſeverely puniſh'd. The *Savages*, who live in *America*, do prove this to be a law of Nature, by the keeping of their *Nuptial Beds* undefiled, *Adultery* being ſcarcely known amongſt them; and if ever any be found guilty thereof, they have horrid *puniſhments* inflicted upon them. And tho' after *Marriage* the *Husband* be the *Head* of the *Wife*, and that by the Prerogative of his *Sex* he is to have the *Dominion*, and that all *Domeſtick Affairs* are to be ordered according to his Command and Direction; yet he is never a whit leſs obliged to keep his *Conjugal Promiſe*, than the *Wife* is; and if he happen to break the ſame, he needs not think ſtrange if his *Wife* take the ſame courſe, and write after the Copy he ſets her.

IV. *Married Perſons are bound to keep the Faith they have pledged to each other.*

Foraſmuch as a *Houſe* or *Family* ſeems to be perfect and compleat in a *Husband* and *Wife*, and that the welfare of a *Family* conſiſts in their Concord and Harmony; it highly concerns them diligently to mind their *Duties*. Now the *Duty* of a *Husband* is *to love his Wife*, and to be tender of her, as of a part of himſelf; according to that of *Geneſis*, *and they two ſhall be one Fleſh*. Neither is it ſufficient that he make her the Companion of his *Bed*, but alſo of his *Counſels*, leſt ſhe ſhould conceive her ſelf to be contemned and ſlighted, and thereupon, out of Indignation, neglect her *Family* Affairs. If he admit her into Partnerſhip of all his concerns, this will make her chearfully to undergo any pains or trouble, and ready to comfort, aſſiſt and help him in any occaſion of Grief of *Mind*, *Bodily Sickneſs*, or outward *Loſſes*. But if a *Man* hath had the ill luck to meet with an ill natur'd *Wife*, he ought firſt of all to uſe his utmoſt induſtry to engage her to her *Duty*, by ſweetneſs and fair means. And if after all, ſhe continue in her perverſeneſs, he may have recourſe to a *Divorce*, or ſome other way the *Law* allows; or elſe by Patience endure what cannot be mended, eſpecially ſeeing that he cannot divulge the faults

V. *The Duty of a Husband*

of

of his *Wife*, without the hurt of his *Children*, the infamy of the *Mother*, and the disgrace of his *Family*.

VI. *The Duties of a Wife.* 'Tis the *Duty* of a *VVife*, not only to *love her Husband*, but to *Honour* him, to subject her self to his *Command*, as to her *Head* and *Lord*. And because she is more fit for the managing of *Houshold Affairs*, her business must be to take care of them, and to provide for the Convenience and welfare of all those that belong to the *Family*. And on either side is required union and concord of *Mind* and *Body*, that they may have but one will between them, and never be divided by any difference or contest. According to that of HORACE, *Carm.* 1. *Od.* 13.

O Happy thrice and more, that Faithful Pair,
In Bands of lasting Love that joined are;
VVho without Angry Broyls their days do spend,
VVhose Love no sooner than their Lives shall end.

VII. *Matrimony is to be celebrated between Equals.* To the begetting of this *Concord*, it is very conducive, that there be a *Parity* between the *married Couple*, and not too great an inequality of condition between them. For seldom are those *Marriages* found to be happy, where there is a great difference between the *parties* conjoin'd. Seeing that great disparity of *Fortune*, *Age* and *Manners*, are frequently the cause of as great differences and dissentions: but those above all other are frequently found the most unfortunate, that are contracted between persons of a different *Religion*. For as TERTULLIAN saith, how can it be imagined, but that the *Faith* must be weakned and obliterated, by continual and intimate commerce, with one of a contrary *Belief*? Wicked *Discourse* is apt to corrupt good *manners*, how much more the individual intimacy of *Conjugal Cohabitation*? How can a Believing *VVife* serve two *Masters*, *Christ*, and *her Unbelieving Husband*? Neither hath a *Husband* less cause to fear the Snares of an *Infidel VVife*, which SOLOMON himself, tho' the wisest of Men, could not avoid, and *Children* also being mostly left to their *Mothers* care, are in great danger to be inveigled with her sentiments. And what is worst of all, from the different *Religions* of *Father* and *Mother*, as from two *Animals* of a different *Species*, *monstrous* Births are commonly produced, being of no *Religion* at all, and such as prove unhappy Prodigies in the *Church* and *Commonwealth*.

CHAP. XXXIII.

Of the Duties of Parents and Children.

I. *Of the Caution that is to be used in Cojugal Cohabitation.* FOrasmuch as from the Individual Society, and Cohabitation of *Man* and *Wife Children* do proceed, and by means thereof the succession of *Families*, *Kindred*, *Estates* and *Titles* are perpetuated; it highly concerns *Parents*, that they behave themselves prudently in the *Conjugal Union*, lest by their intemperance their off-spring be vitiated. For it was not without Reason, that some have been reproached with this stinging Taunt, *Thy Father begot thee when he was drunk*. For the *Vices* of the *Parents*, are frequently transferr'd to their *Children*; and the very temper of their *Bodies*, is a cause either of the commendable, or perverse Manners of them.

II. *The Duty of Mothers.* The *Duty* of the *Mother*, is to take care that the *Child* in her *Womb* do not come to any hurt, and when Born, that she sollicitously cherish it, and suckle it her self, and that she do not put it out to a *Nurse*, without urgent necessity. As soon as it comes to the use of reason, she must also endeavour to form its tender and pliable Manners, according to the rules of *Vertue* and *Piety*, and to instil into it the first *Principles* of *Religion*.

III. *The Office of Fathers.* But because it imports little to have given Life to *Children*, and thereby to put them into a State, that is indifferent to either *Vertue* or *Vice*, except due *Instruction* be superadded, and the *Hatred* of the one, and *Love* of the other be inculcated into them; it is the *Fathers Duty*, to take care that they be timely taught, according to his Ability and Condition, and he must omit nothing, that may conduce to their advancement in *Learning* and *Good Manners*. If he be able, let him put them out to *School*, to the end that being out of their *Mothers sight*, and rid from her fondling of them, they may mind their *Learning* the better: But he must so resign the care of their Instruction to others, as not wholly to neglect it himself, but must have an Eye to the Progress they make, by prescribing what they ought to learn, and judging what may be omitted: Except he be assured of the Ability, Care and Prudence of the *Masters*, with whom he hath intrusted them.

IV. *Parents are bound to maintain their Children.* Another *Duty* of *Parents* is, that they take care of the *Bodily Sustenance* of their *Children*; and in case they want wherewith to maintain them, that then they take care to teach them such *Arts*, whereby they may be able to maintain themselves, without being burthensome to them. Neither must only *Legitimate Children* be maintained by *Parents*, but *Natural* also, that is, such as are Born without *Wedlock*. For according to the *Law* of *Nature*, they ought to be provided for by their *Parents*; and tho' they cannot be said to be Members of the *Commonwealth*, yet they are like *Warts* and *Corns*, which tho' they be no parts of the *Body*, yet are fed from the substance of the *Body* to which they adhere. And therefore *l.* 3. *de inof. Test.* *Bastards* are allow'd an *Action* at *Law*, whereby they may oblige their *Parents* to give them a *Maintenance*, as well as if they were *Legitimate*.

V. *Parents must love their Children alike.* *Parents* likewise are obliged to bear an equal *Love* to all their *Children*, without putting any difference between them; for seeing they all of them stand in the same relation to their *Parents*, they ought also to be cherished with the same *Love* and *Affection*; neither is any difference to be made between them, as to their right of *Inheritance*, except the particular Prerogative of *Primogeniture*, and where the *Laws* of the *Society*, wherein they live do require it. Wherefore the *Civil Law* gives the *Children power* of bringing an Action of an *inofficious Testament* against a *Father*, who by his last *Will* bequeaths his Estate to others, passing by his *Sons* and lawful *Heirs*; and the *Falcidian Law* allows them the fourth part of the *Estate* to be equally shar'd amongst them. But yet it is lawful, and permitted to *Parents* to love them more, and bestow more upon them, in whom they discern more *Obedience* and *Vertue*; because this is no more than is due to their worth, they being no otherwise preferr'd before

To the Worshipfull Peter Rycaut of King Stephens
Castle in Ospring in Kent Esqr., only Son and heyre
of Collonell Phillip Rycaut, And Nephew to the
Right Worshipfull Sr. Paul Rycaut Knight,
Envoy Extraordinary to their Majesties of great
Brittaine in Hamburgh; And to Chorlotte his Wife,
Daughter of Sr. Gilbert Gerard Baronet deceased.
This Plate is humbly Dedicated by Richard Blome.

Leon. Inv. I. Kip Sculp.

To the Right Worshipfull S.r Robert Clayton of
Marden in Surrey, and of the Citty of London
Knight and Alderman Lord Mayor thereof
Anno Domini 1680, And to Martha his
Lady Daughter of M.r Perient Trott
of London Merchant.

This Plate is humbly Dedicated by Richard Blome.

before the reſt of their *Bretheren* or *Siſters*, but as they are more worthy.

VI. *Children are under the Power of their Parents.*

Parents by a natural right have *power* over their *Children*, for ſeeing that the care of them is by nature committed to the *Parents*, they would never be able to exerciſe the ſame, except they had Authority over them, to direct their *Actions* for their *Good*. And accordingly the beſt of *Parents*, do without any injury to them, force their *Children* to follow their Studies, to behave themſelves as they ought, to leave the vicious inclinations of their Nature, and to do thoſe things which for the future, may make them good, and profitable Members of the *Commonwealth*. Now whilſt the *Father* is in this exerciſe of his *power* over his *Children*, there is beſides a great Obligation incumbent upon him, that as he is the head of the *Family*, he take care alſo to impart *Health* and *Strength* to the reſt of the *Members* of it; that is, that he recommend *Vertue* to them by his Example; and that he excel all the reſt by his *Life*, more than by his *Tongue* or *Inſtructions*. That he deny and force himſelf, and that like an *Eagle* he provoke his young ones to fly; that he curb his *Paſſions*, that he may the more effectually excite them to follow the Footſteps of *Vertue*; and in a word, that he omit nothing whereby their tender ſpringing *Vertue*, may thrive and flouriſh.

VII. *The Power of Parents over their Children is limited.*

The power of *Parents* over their *Children* is bounded: For it is not lawful for them to kill the *Birth* of their own begetting in its *Mothers Womb*; nor when it is *Born*, may they neglect, much leſs deſtroy it. For tho' their *Children* proceed from them, and be form'd out of their very *Subſtance*, yet are they born in the ſame condition as themſelves, and are capable of being injur'd by their *Parents*. True it is, that of antient time, *Parents* had the *Power* of *Life* and *Death* allow'd them over their *Children*, that they might be the more encouraged to take care of them. But this abſolute *Power* to chaſtiſe the Vices of their Manners, that it might not laſh out too far, was reſtrained by *Law*; It being taken for granted, that *Children* are not only born to the *Parents*, but to the *Commonwealth*; wherefore *l.4. ff.de re milit.* it is enacted, that whoſoever in time of *War*, ſhall refuſe to ſend his *Son* to ſerve the *Commonwealth*, or that ſhall any way maim him, that he may be uncapable to bear *Arms*, ſhall be baniſhed.

VIII. *What are the Duties of Children.*

The *Duties*, or rather the *Debts* which *Children* owe to their *Parents* are: Firſt, that they *Honour* them, with all poſſible Obſervance and Obedience, and with an awful Veneration ſubmit themſelves to them. For it is their *Duty* to acknowledge their *Preeminence*, and their *Dominion* over them; from whence the *Royal* and *Civil* Power are originally derived. And this *Honour* is in a twofold manner exhibited unto them; *Inwardly*, by the Affection and Eſteem they have for them; and *Outwardly*, by their *Words* in *Speaking* to, and of them with all Reverence and reſpect; by *Signs* and *Effects*, as by riſing up to them, ſerving them, ſtaving off *Harms*, and procuring their *Good* and welfare; by *obeying* their *Commands*, by ſubmitting to their *Will* in all things, and by undertaking nothing without their *Authority* and *Counſel*.

IX. *Children are bound to maintain their indigent Parents.*

In the Second place, *Children* are bound to ſuccour and relieve their *Parents*, if they be Poor and neceſſitous, as being Debtors to them. This is that which *Nature* teacheth, and which obtains amongſt all *Men*, by the *Law* of *Nations*. It is an ancient *Law*, quoted by *SENECA*, *Controverſ.* 1. *Let Children maintain their Parents, or elſe be caſt into Priſon.* Becauſe *Parents* here on *Earth*, are inſtead of *GOD* to their *Children*, tho' they may labour under Adverſity and Poverty. They are as *Creditors*, to whom tho' they be impious and contemners of the *Laws*, the *Debt* that is due to them muſt be paid notwithſtanding. They are like ſo many Sovereign *Princes*, whoſe *Actions* and *Counſels* the *Subjects* may not pry into. And therefore *Divines* determin, that if a *Man* ſhould meet with his *Father* and his *Son* in the ſame danger, and that he can only ſave one of them, he is bound to reſcue his *Father*, rather than his *Son*. For to this he is bound by the tye of *Blood*, *Reverence* and *Gratitude* he owes to his *Father*; ſince he may have another *Son*, but cannot have another *Father*.

CHAP. XXXIV.

Of the Duties of Maſters and Servants.

I. *The Original of ſervitude.*

After that *Men* were multiplied by *Generation*, *Servitude* was introduced into the *World*, and they who were born free, were forc'd to own *Superiors*. For after that *Dominion* and *Government*, was come into the *Hands* of a few *Men*, many being compell'd by Poverty, or by the Dulneſs of their *Intellectuals*, did proffer their *Labour* and *Service* to great *Men*, upon condition of being maintained by them, and ſupply'd with neceſſaries. Afterwards by the occaſion of *Wars* ariſing between ſeveral *Nations*, and the longeſt *Sword* carrying it, it ſo happened that they who were taken in *War*, were made *Slaves* to thoſe who had conquered them. And therefore the *Latin* word *Servus*, which ſignifies a *Slave* or *Servant*, is derived from *Servo*, which ſignifies to *Save*, becauſe they were ſuch as in *War*, were ſaved alive by the *General*. §.3. *Juſt. de Jur. Perſon.*

II. *How Chriſtians become Servants.*

But this *Cuſtom* is antiquated amongſt *Chriſtians*, and it is a received *Law* amongſt them, that no *Chriſtians* may be made *Slaves*. Tho' when *Chriſtians* wage *War* againſt *Infidels*, and are taken by them, they make *Slaves* of them, becauſe this is the Common Law of *Nations*; and this Servitude is a kind of *Permutation* for the *Death*, to which it was in the power of the *Infidels* to make them ſubmit. For tho' it be contrary to *Nature*, to enſlave a *Man* that is born free; yet it ſeems conſentaneous to *Natural right*, that he who raſhly takes up *Arms* againſt one that is more powerful than himſelf, and will not hearken to *Peace*, being taken *Captive* by the *Conqueror*, ſhould be obliged to ſerve him, and be ſubject to his Command.

III. *Two ſorts of Servants.*

The are 2 ſorts of *Servants*; the *one*, of thoſe who contrary to the *Law* of *Nature*, are entirely at the *Will* and diſpoſe of a ſtrange *Lord* or *Maſter*: *Another* are ſuch, as let themſelves to others for *Hire*, and give them their Labour for Recompence or *Reward*.

IV. *The mutual Duties of Masters and Servants.*

The *Master* is bound to pay to his *Temporary Hired Servant*, the *VVages* he hath agreed with him for, and be as good as his *VVord* to him; as the *Servant* on the other hand is obliged to perform the *VVork* and *Service* he hath agreed to, and diligently effect whatsoever else he hath engaged himself to do. And forasmuch as in this their mutual *Contract* and *Agreement*, the condition of the *Master* is above the *Servant*, an *Obligation* ariseth thence in the *VVorkman*, to carry himself with all Reverence to his *Master*, according to the degree of *Dignity*, wherein he is placed above him. If he have not been *faithful* in performing, what he had engaged himself to do, or not diligent enough in his *VVork*, that he willingly submit himself to his Correction, to receive the reward of his *Negligence* or *VVickedness*. If a *Servant* either driven by necessity, or of his own accord, have put himself into any ones *Service*, his *Master* is bound to provide for him accordingly. Neither can the *Ingratitude*, or *Obstinate humour* of the *Servant* deliver him from his *Obligation* herein; tho' for a *Punishment* of his *Offence*, he may diminish his allowance of *Food*, to chastize his negligence or sturdy humour. Yea if he should neglect the *Commands* laid upon him, and should refuse to go through the work he had undertaken, the *Master* may withold part of his *Wages*, which he had agreed with him for.

V. *A Master is bound to pay for his Servants.*

A *Master* is bound to make Good the Damage done by his *Servants*: Because the fault of his *Servant* is imputed to be his; and according to the *Lawyers*, an *Action* may be had against the *Master* of the *Bondslave*, for any Damage *Culpably* committed by him: And accordingly the *Master* must either make good the *Damage*, or deliver his *Slave* to him who hath suffered the *Damage*. Thus the *Master of a Ship* is bound to make good the loss of it, in case it chance to miscarry in a *Tempest*, for want of a good *Steersman*. I added *Culpably* committed by him, because if the loss happen without his fault, neither the *Servant* nor *Master* are bound to make it good, except that it can be proved, that he is grown Richer by means of the said loss.

VI. *The care of Masters towards their Servants.*

A *Master* must not suffer his *Servants* to be *Saucy* or *Idle*, and if he finds them remiss and negligent in their *Work*, he ought to reprove and chastise them. If they commit any *Crime*, he may punish them according to the quality of it, yet not over-cruelly. I call a too cruel *Punishment*, *Maiming*, *Wounding*, or such *grievous beating* whereby the *Life* of the *Servant* would be endanger'd, or at least the loss of one of his *Members*. It is only permitted therefore to a *Master*, to correct his *Servant* by a *lighter* sort of *Punishments*, as by *beating* him in such a manner, whence no hurt can redound to his *Body*. For seeing that *Servants* are subject to their *Masters Chastisements*, they ought to submit to that *Punishment*, he thinks fit to inflict upon them.

VII. *Servants can enter into Covenants.*

Servants notwithstanding the tye they are under, yet can enter into *Covenants* or *Contracts*, so that by this means they may be under an *Active*, as well as *passive Obligation*. For tho' *Servitude* do restrain the *Power* of *Servants*, and almost deprives them of *Civil Rights*; yet it leaves them in full possession of the *Law* of *Nature*, which by no means can be abrogated. And accordingly *JUSTINIAN* tells us, *Inst. de Jur. Nat. Gent. & Civil.* That *Natural Laws* which are equally observed by all *Nations*, are the constitutions of the *Divine Providence*, and as such do always continue firm and immutable. Whence it follows, that both *Servants*, and those with whom they have contracted, are in the *Court* of *Conscience* bound to the *Observation* of their *Agreements*, and the faithful performance of what they have engaged themselves to do.

VIII. *Servants cannot alienate the Goods of their Masters.*

Servants have no power to alienate their *Masters Goods*, no not so much as to give an *Alms*; for seeing that no Administration of their *Goods* is committed to them, and that it is a piece of Injustice to relieve the *Poverty* of the Indigent out of the substance that belongs to another, it is clear that they cannot bestow any thing upon the *Poor*; without it can be probably supposed, that they have their *Masters consent* for it; or that the necessity of the Indigent be so extream, that it may seem to plead an excuse for the irregularity of the fact.

IX. *Servants are not bound to obey their Masters in any thing that is Evil.*

Servants are not bound to obey their *Masters*, in those things that are *Evil* in their own *Nature*, that is, which are contrary to the *Laws* of *Nature* or *Nations*, or to the *Law* of *GOD*, whatever advantage either themselves or their *Masters* might hope to reap from it. Because we are never to do *any Evil that Good may come of it*. Wherefore they who either by their *command* or advice, do intice their *Servants* or others to *Evil*, or that put an occasion of doing mischief into the Hands of others, to the end that they may get some advantage thereby, do greatly Sin in so doing, they making themselves guilty of the Crime, who persuade or command it.

CHAP. XXXV.

Of the Right of Sovereign Dominion, and the different forms thereof.

I. *When Sovereign Power had its rise.*

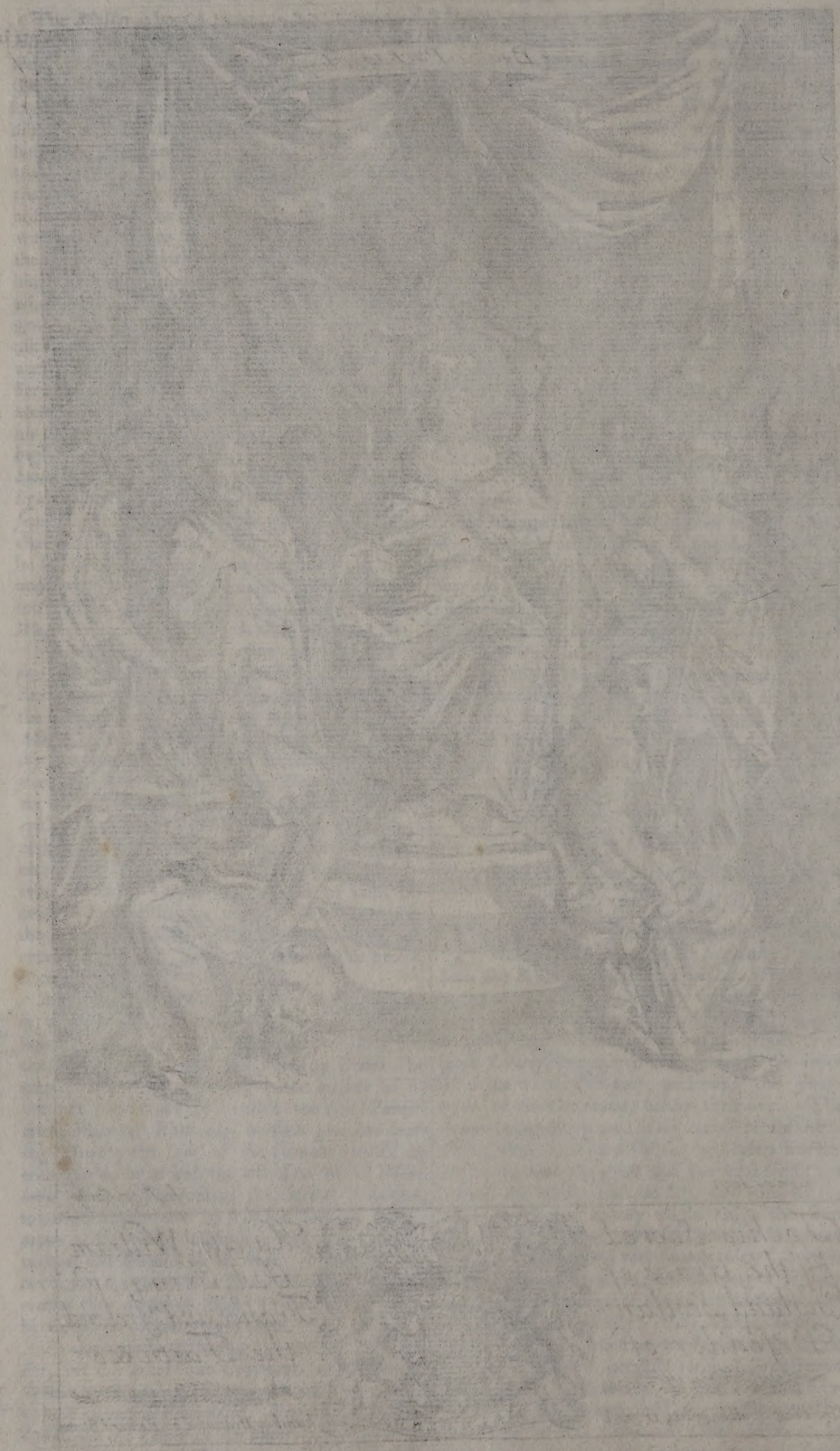
THE *Right* of *Sovereign Dominion*, besides what is *Paternal*, took its *Beginning*, when *Men* like *Beasts*, lived in the *Fields*, *Woods* and *Caves* of the *Earth*: for being wearied with this irregular kind, they began to think of entring into *Societies*, and voluntarily divesting themselves of their *Liberty*, committed themselves to the disposal of the whole *Company*, preferring the *Judgment* of the *Community* before their own. The *Power* being thus placed in the Hands of the Multitude, they took care for the particulars belonging to it, that the great and powerful might not oppress the weak and needy, and that all the *Members* of the *Society* might enjoy the same Freedom of *Living*. But forasmuch as in process of time, it was found very inconvenient, both as to the deliberating about, and deciding of *Affairs*, to gather the suffrages of the whole *Multitude* belonging to the *Society*; they agreed that this *Power* should be setled on one *Person* only, or on a few. Whence a threefold form of *Government* took its Rise; so that now, as TACITUS expresseth it, all *Nations* and *Cities* are Governed by the *People*, or the *Great* and *Chief* Men, or by *Sovereigns*; so that the *Supream Power* is sometimes in the Hands of a single *Person*, or of a few, or in the Hands of the *Body* of the *People*.

When

Lens. Inv. I. Kip Sculp

To his Sacred Majestie William
by the Grace of God, King of
England, Scotland, France, and Ireland,
Defendor of the Faith &c.

This Plate in all humility is most humbly Dedicated by Richard Blome.



II. *Of the three kinds or forms of Government.*

When the *Sovereign Command* is in a *single Person*, this is call'd *Monarchy*, becauſe he Governs the whole *People*, and himſelf is commanded by none; as the Kingdom of *France*, *Spain*, *&c.* When the *Supream Power* is lodg'd in a *Council* of a few ſelect *Citizens*, this is call'd *Ariſtocracy*; ſuch as obtains in the *Commonwealth* of the *Venetians*. And laſtly, When the Command is in the Hands of the whole *Body* of the *People*, it is called *Democracy*, or a *Popular Government*; ſuch as is in *Holland*. Every one of theſe Forms of *Government*, hath its own Peculiar and Fundamental *Law*, which it more particularly inſiſts upon; *Democracy*, that of *Liberty*; *Ariſtocracy*, *Security* and defence from the *Common People* and *Tyrant*; and *Monarchy*, *Sovereign Power*, employ'd for the ſafeguard of the *Publick Good*.

III. *The Worthineſs of Monarchy.*

Monarchy therefore is, when the *Supream Power* is lodg'd in one Perſon, on whom all the reſt do depend. Altho' this Form of *Government* may agree with the other two, yet doth it excel them both, as poſſeſſing more Advantages than either of them. For *Monarchy* hath this Peculiar to it ſelf, that it is *more free* in the Exerciſe of its *Power*, and can deliberate and determine without any ſet Time or Places, it being at the King's Liberty to Deliberate or Determine at any time, or in any part of his *Kingdom*. Moreover it is obvious, that in *Kingly Government*, *Counſels* are carried on, as well as reſolved, with greater Secrecy; Executed more readily; *Factions* and *Seditions* more eaſily prevented and cruſh'd; and *Safety* and *Liberty*, which the other Forms of *Government* ſo much affect, doth more abound, and is more laſting than in the two other Forms.

IV. *In it all things are better adminiſtred.*

If there be any Deliberation concerning the *Peace*, *Union*, and the *Higheſt Good* and Intereſt of the *People*, the Power concentred in One, will be able better and more readily to effect it, than the reſemblance only of this Unity in many can poſſibly do it. Beſides, that Form of *Government* muſt needs be the beſt, which moſt reſembles the Eternal and Undivided *Government* and *Empire* of *Almighty GOD*: As alſo, becauſe he whoſe Command continues as long as his *Life*, doth thereby become perfect in the Art of *Ruling*, and looks upon the whole *Body* of the *People* as his own *Family*, and embraceth and cheriſheth them with a Paternal affection and tendermeſs.

V. *What a Tyrant is.*

The oppoſite of ſuch a *Prince* as we have now deſcribed, is a *Tyrant*, who either gets into the *Throne* contrary to the *Laws* and *Cuſtoms* of the *Kingdom*; or, who being lawfully advanc'd to it, doth only mind his own private Good, and fills the Society with *Dread*, *Poverty*, and *Calamity*. He who, contrary to *Law*, aſpires to the *Sovereign Dignity*, and leaves nothing unattempted to obtain the Kingdom he has in his Eye: He who by the *Maſſacres* and Deſtruction of the *People*, the *Proſcription* of the *Grandees*, and the taking away of their *Lives*, makes his way to the *Throne*; without being aſham'd of oppreſſing and grinding the *People*, or of deſtroying the Innocent, ſo he may but obtain what he hopes for. For *Monarchy* is not always ſuch as it ought to be, but by the *Vices* of wicked *Princes*, is often turned into *Tyranny*. But certainly, the State of a *Tyrant*, whatever he may think of himſelf, is very miſerable, who dreads thoſe whom he oppreſſeth, and flees thoſe whom he perſecutes, the Fear he puts his *Subjects* into, recoyling back upon himſelf. Seeing, that as SENECA ſaith, it is unavoidable, but that *He whom many fear, muſt fear many*.

VI. *The Defects of Ariſtocracy.*

Neither is *Ariſtocracy* ſubject to leſs Inconveniences than *Monarchy*; whilſt Wicked Men out of an ambitious deſire of *Rule*, do by unjuſt Means endeavour to get into the *Senate*; following that Maxim, *If Right be to be violated, let it be done for the obtaining of Rule and Government*. Whilſt by the Prevalency of a *Faction*, unworthy Perſons are Elected, and *Vertue* and *Deſert* poſtpon'd: Whilſt thoſe few that have the Power in their own Hands, do only mind the enriching and aggrandizing of themſelves, and without being ſolicitous for the Good of the *Subject*, do treat them no otherwiſe, than if they were their *Slaves*.

VII. *The Inconveniences of Democracy.*

Neither is *Democracy* ſubject to leſs dangerous Diſtempers; as when the *People* in whom the Power is lodg'd, manages the *Government* in a turbulent and tumultuary manner; when the more *Rich* and *Powerful* part of the *People*, do oppreſs and devour the leſſer Fry, contemn the *Magiſtrate*, violently ſeize the *Goods* of others, without having the leaſt regard to thoſe that are Good and Innocent: When they make *Laws* from an itching deſire of *Novelty*, and ſoon after as inconſiderately annul them again: When they Enact and Decree that one day, which they abrogate the next; and *exauctotate*, what but a while ago ſo highly pleaſed them: Or, when *Men* unfit and of no Capacity, are raiſed to the higheſt Charges: And, when *Men* of an inſolent and inſulting Temper, do pronounce unjuſt Sentences, and enact burthenſom Decrees, and afterward maintain and execute them by unjuſt Rigour.

CHAP. XXXVI.

Of the Duties of Sovereign Princes.

I. *Knowledge of Affairs is neceſſary to a Prince.*

IT is very much for the Intereſt of the *Commonwealth*, that He who either by Nature or Chance is deſtinated to the *Government* and defence of *Society*, ſhould not only excel others in *Vertue*, but alſo in *Knowledge of Buſineſs*, eſpecially of thoſe which appertain to his *Function*. For how ſhall a Man be able to perform that he doth not underſtand? Or preſcribe *Laws* to them, whoſe Temper and Inclinations he is not at all acquainted with? Wherefore it ought to be his great concern to mind this only, and contemning his Pleaſure and Divertiſments, to exerciſe himſelf in thoſe things which conduce to this end.

II. *The great aim and deſign of a Prince, muſt be the Publick Good.*

The *firſt* thing therefore that is to be minded by him that has the *Sovereign Power*, is, that the ſame has not been committed to him for his own ſake alone, but for the *Publick Good*. For as the great End, as CICERO tells us, of the *Maſter* of a *Ship*, is *a proſperous Voyage*; that of a *Phyſician*, the *Recovery of his Patient*; that of a *General*, *Victory*: So the End of a *Governour*, is the *happineſs* and *welfare* of the whole *Community*, that ſo his *Subjects* may abound with *Riches*, be expert at their *Arms*, Renowned abroad, and Vertuous at Home.

III. *Vertue and Wiſdom is requiſite in a Prince.*

A *King* will the more readily obtain this End, if he endeavour to excel all others in *Vertue* and *Wiſdom*, as he is above them in Place and Dignity. For ſeeing that the whole *World* are apt to imitate the Manners of their *Prince*, and his *Vertues* or *Vices*, are commonly the Copies his *Subjects* write after; it is his greateſt Intereſt to purſue *Vertue*, and lead a Good *Life*, that he may not be the Cauſe of Corrupting his *Subjects*, and encouraging them to *Sin* and *Wickedneſs*. Beſides, how will a *Prince* ever be able to keep up his *Authority* and *Dignity*, if he be accounted Flagitious and Vicious? Or with what Face will he be able to preſcribe *Laws* of *Temperance* to others, who lives in the continual breach of the *Laws* he preſcribes?

IV. *Piety, Juſtice, Valour and Clemency, are the neceſſary Vertues of a Prince.*

Of all *Vertues*, none is more neceſſary to a *Prince*, than that of *Piety*, to the end he may obtain of the Great *GOD*, by whom *Princes* Rule, *Ability* and *Wiſdom* for the bearing of the Great Burthen that lies upon him; as well as that by means thereof, he may more powerfully engage to himſelf the *Hearts* of his *Subjects*, by their being perſuaded, that he muſt needs be the peculiar Care of that *GOD*, whom he ſerves with ſo much *Religion* and *Devotion*. He muſt likewiſe be adorned with *Juſtice*, that he may Adminiſter the Affairs of his *Kingdom* with *Equity*, Puniſh the Wicked, Reward thoſe, who by their good *Services* have defended or promoted the Intereſt or Glory of the *Commonwealth*, and with a conſtant and unchangeable *Will*, give to every one his due. He muſt alſo be qualified with *Valour* and *Clemency*, that by the one he may keep Ill-men to their *Duty*, and by Fear reſtrain thoſe who are apt to be *Factious* and *Seditious*, and to diſturb the Peace of the *Commonwealth*: And that by the other, he may be ready to Forgive, and gain the *Hearts* of his *Subjects* by his Goodneſs and Benignity. *Liberality* alſo is a *Vertue* that well becomes a *Prince*, as being of uſe to him, not only for the obliging and rewarding of his Good *Subjects*; but alſo to acquire the Reputation of *Bountiful*, which is ſo generally taking, and ſo highly eſteem'd amongſt Men. But yet a *Prince* muſt be *prudent* in the Exerciſe of this *Vertue*, ſo as to make choice of Worthy Perſons, on whom to beſtow his Munificence, leſt by gratifying Baſe and Undeſerving *Men*, he ſtir up *Envy* and *Hatred* in the Hearts of his *Subjects*, and expoſe himſelf to their Reproaches and Contempt. In a word, There is no *Vertue* which is not neceſſary for him, who is plac'd on high to be an Example to others, and whoſe private *Sins*, by their ſpreading Contagion, come to be *Epidemical Vices* of the whole *Commonwealth*. For who ſtands in greater need of *Prudence*, than he whoſe *Function* it is to deliberate concerning things of the higheſt moment? Who hath occaſion for a more unchangeable Truth and Faithfulneſs to his *Word*, than he, who is greater than the *Laws*? Who ought to be ſo qualified with a more reſolved *Conſtancy*, than he who is entruſted with the Concerns and Welfare of all? Who wants a higher degree of *Continence*, than a Perſon to whom every thing is ſubject? Or whom doth *Vertue* become better than him, who hath all Men to be his *Spectators* and *Witneſſes*?

V. *A Prince ought to be well acquainted with the Nature of his Kingdom.*

Another *Duty* of a *Prince* is, that he be well acquainted with the Temper and State of his *Kingdom* and *Cities*: Becauſe the way of Governing is not every where alike, and according to the different Condition of *Kingdoms*, different *Laws* are to be Enacted accordingly. In the *Firſt place* therefore, he ought to know what are the *Fundamental Laws* of his *Kingdom*; whether the *Government*, to which he is elevated, be purely *Monarchical*; or whether it have an allay of *Ariſtocracy* and *Democracy*? What part the *Nobles* have of the *Government*, and what the *Commons*? And in the next place he ought to know the Largeneſs of his *Kingdom*, the *Situation*, *Commerce*, and *Strength* of it: Who are the *Neighbours* that bound upon his *Kingdom*, and what Profit or Inconvenience may accrue to him from their mutual Friendſhip or Diſcord.

VI. *As alſo with what paſſeth in Foreign Countries.*

A *Prince* alſo ought to be well informed concerning what paſſeth in *Forein Countries*, that he may be the more ready to counterwork and oppoſe their Deſigns, to the prejudice of his *State*. For ſeeing that *Civil Societies* are as in a perpetual State of *War* and *Hoſtility*, and that in this State *Men* are not obliged to keep their *Treaties*: When one of the Parties gives occaſion to the other, to diſtruſt his Faithfulneſs; it is highly neceſſary, that a *Sovereign* have good Intelligence concerning the Enterprizes and Deſigns of *Strangers* againſt his *State*, to the end, that if he find they intend to break their *Treaties* with him, he may not think himſelf obliged to keep his. And ſo to be always ready, either for *Peace* or *War*.

VII. *A Prince ſtands in need of Faithful Counſell or*

It is a great Argument of the *Prince*'s *Prudence*, to make choice of Wiſe *Counſellors*, Men Eminent for their *Honeſty*, *Great Experience*, *Faithfulneſs* and *Prudence*. He muſt alſo take care, that he be not offended with *Truth*, if any thing be ſpoke or advis'd by them contrary to his *Mind*; but let him embrace and encourage *Sincerity*, and contemn and hate *Flattery* whereſoever he meets with it.

VIII. *Muſt have an Eye to the Adminiſtration of his Chief Miniſters and Great Officers.*

He ought alſo to take great heed, that his *Officers* and *Lieutenants* keep within the bounds of their *Duty*, and that they may not be injurious to any. That thoſe who are the *Governours* of *Cities* and *Provinces*, do not enrich themſelves by oppreſſing of the *Subjects*: That the *Chief Commanders* of his *Army*, keep their *Souldiers* within the bounds of due *Diſcipline*, not ſuffering them to violate the *Martial Laws* without preſent *Puniſhment*: That the *Judges* exerciſe *Juſtice*, and render to every one what belongs to them. Of all which things, I have handled at large in my Treatiſe of the *Beſt Government*, to which I refer my Reader.

IX. *The Duties of a Prince in time of Peace, is to take Care of Religion*

But foraſmuch as the *Duties* of a *Prince* do relate either to a Time of *Peace* or *War*, we muſt alſo treat of them in particular. His firſt *Duty* therefore in Times of *Peace* is, that he take care to promote the *Honour* of *GOD*, and encourage *Religion* and *Godlineſs*, and ſuffer no Innovation in Matters of *Worſhip*. By which means he will have *GOD* to favour him in all his Undertakings, and will engage his *Subjects* to have a great Eſteem and Veneration for him.

X. *To encourage Arts.*

In the *Second place*, he ought to be careful in encouraging and promoting all *Arts*; not only those which are surnamed *Liberal* or *Ingenuous*, and which are of great Advantage and Honour to the *Government*; but others also, which we call *Mechanical*, and especially those that are of greatest use to the *Commonwealth*, and bring the greatest *Profit* and *Riches* to the *Kingdom*; as are those of *Agriculture* and *Navigation*, whereof the former furnisheth his *Subjects* with the Necessaries of Life; and the latter carries on *Trade* with *Foreign Nations*, and is a means of enlarging his *Dominions*, and bringing Treasure to his *Coffers*. And what is more, *He that is Master of the Sea, may* in some sense, *be said to be Master of the Land also.*

XI. *To keep and perform his Treaties faithfully and punctually.*

Thirdly, A *Monarch* must be careful to observe the *Peace*, and other *Treaties* he hath made with other *Nations*, so as never to suffer the same to be violated. For nothing is more shameful or hazardous to a *Sovereign*, than to break his *Word*; because by this means he teacheth his *Subjects*, upon occasion, to serve him after the same manner, and to revolt from him.

XII. *To have an Army always in a readiness.*

Fourthly, He must make it his business to be always provided of a good *Army*, to prevent the *Faction* of any of his *Nobles*; or to suppress the *Conspiracies* or *Rising* of any other of his *Subjects*. I understand by *Faction*, *a Company of Seditious Persons, which have united themselves for the carrying on of some design, without the permission of him who governs the State.*

XIII. *To curb all Ambitious and Aspiring Spirits.*

He must also be mindful to curb and restrain *Ambitious persons*, and such who have a disposition to *Rebel*, and to put the State in confusion. For seeing that there are in all *Governments*, Persons who suppose themselves more wise and able to manage the *Publick Affairs*, than those who are charged with them, they will not be wanting by all manner of ways to defame and reproach their Conduct; and not finding their Ambitious desires satisfied in the present state of *Affairs*, would be ready to overthrow the Settlement, if the *Prince* were not always in a readiness to oppose and crush their Designs.

XIV. *To restrain Factions.*

Fifthly, In case it happen so, that he be not in a condition, to break the grown *Faction* in his *Kingdom*, that then he make use of Men esteemed for their *Piety* and Worth, before that he have recourse to *Arms*, that by their Authority and Favour they may appease the Minds of these *Mutineers*, and bring them to Reason. And in case they are stubborn, and will not acquiesce in their *Reasons*, not give ear to their Exhortations, that then he resolve to vindicate the Contempt of his Authority by force of *Arms*, and to crush the *Rebellion* in the *Egg*, lest being grown strong, it prove troublesom to him, and render the *Sore* incurable. To this end it will be very conducive, if the *Sovereign* take care, by all means, that his *Subjects* may be eminent for *Vertue*, and abound with *Riches*, and be plentifully stored with all the Conveniences and Necessaries of *Life*, but yet without Excess. For as *Physicians* tell us, that *Diseases* are caused by Intemperance or Excess in *Eating* or *Drinking*: So the Corruption of *Manners*, the Contempt of the *Laws*, and the Insolence of the *People*, is often caused by the too great affluence of *Riches*; except the *Prince* takes care to prevent it, by engaging the *Rich* to contribute liberally to the Necessities of the *Poor*, and by the abundance of their *Wealth*, relieve the Wants of their Indigent Neighbours.

XV. *What are the Duties of a Prince in reference to War.*

But because the *Sovereign Majesty*, as JUSTINIAN saith, must not only be armed with the *Laws*, but also fenced with *Arms*, that he may be in a condition to govern his *Kingdom* successfully in times of *War*, as well as *Peace*; he is to take care, that he do not engage himself in any *War* rashly, nor indeed without urgent Necessity. As a *Physician*, who hath no recourse to actual Cauteries or Amputation, till he hath in vain attempted all other Means: Whether therefore a *Prince* design to engage himself in an *Offensive War* against any, or that he resolves only to be on the Defensive, he ought to make an exact estimate of his Force, and duly consider whether he be in a condition to execute the Exploit he intends, or to resist the Force of him that attacks his State. For if he find himself too weak for his Adversary, it will be great *Imprudence* for him to attack his *Enemy*, lest by being worsted, he give an occasion to his Adversary to Invade that rightfully, which before he could not do without great Injustice. Wherefore in this case, it will be his Wisdom by *Mediation*, to prevent the Invasion of his *Enemies*, and chuse rather to lose something of his *Right*, than to hazard the Loss of his whole *Kingdom*. For *Right Reason* teacheth a Man, *to seek for Peace by all possible means, and that he never ought to prepare for War, till he find that there is no hopes of obtaining a Just and Honourable Peace.* But on the other hand, when a *Prince*, after extream Provocations, hath taken up *Arms*, and driven the Invader out of his own *Kingdom*, let him enter that of his *Enemy*, and endeavour to make them repent of their Folly, and bring them to Reason: But yet so, as that he may do nothing contrary to the Requirings of *Religion* and *Reason*.

XVI. *What a Prince is to do after Victory.*

After that he hath gotten the *Victory*, let him take care to spare the *Innocent*, and those who have not shewed themselves Inhuman and Cruel in the *VVars*. It is the part of a *Man* of *Valour*, saith TULLY, to look upon them as *Enemies* who contend for the *Victory*, but to consider those that are Conquer'd, as *Men*; to the end that *Valour* may put an end to *VVar*; and *Humanity*, on the other hand cherish and promote *Peace*. Whereas, on the contrary, it is perfect madness to destroy those *Things* or *Persons*, that do not diminish the strength of the *Enemy*, nor increase that of the *Conquerour:* For he who thus inconsiderately and barbarously wastes all before him, doth not look upon the things he destroys to be his own, but to belong to another.

CHAP. XXXVII.

Of the Duties of Citizens.

I. *Whence Cities had their Rise.*

MAN is so great a Lover of *Society*, and doth so much delight in the Company of such as are like him, that he can scarcely frame himself to live alone. But forasmuch as *Society* cannot be long preserved without *Peace*; and *Peace* is the Fruit of *Union*, and *Union* supposeth *Order*; *Order*, *Distinction*; *Distinction*, *Dependance*; and *Dependance*, *Authority*: Hence it came to pass,

that *Men* came together, and first lesser *Societies* and afterwards greater were formed which gave name to *Cities*.

II. *The Duties of Citizens are either General or Special.*

The *Duties* of a *Citizen* may be reduc'd to two kinds, *viz. General*, or *Particular*. The former of these, take their rise from the common *Obligation*, by which they are obnoxious to the *Civil Government*: But the latter proceed from the particular *Duty*, to the performance whereof every one is bound, according to the calling he is in, or the Function impos'd upon him. The *General Duty* of *Citizens* respects either the *Magistrate*, that is, the *Governours* or *Rulers* of the *City*; or the *Body of the City*, that is, the *Members* thereof.

III. *It is the Duty of Citizens to Honour the Magistrate.*

A *Citizen* is bound not only to obey the *Magistrate*, but also to be faithful to them, and shew all *Honour* and *Reverence*. For it is but reasonable and becoming that he should express his Respect to those, whom he knows do excel him in *Dignity*. Since *Dignity* took its name from the latin word *Dignus*, because they were thought worthy to bear Rule over others, and to take care of the *Government*. And accordingly it is very agreeable to reason, that those who are subject to their *Command*, being content with their condition, be *Enemies* to all novelties or innovations in the State, and acquiesce in their Decrees, rather than in those of any other. That they put a good interpretation upon all their Actions, and be not too curious searchers into their *Lives* and *Actions*, but in all things willingly submit to their Commands.

IV. *The Duty of a Citizen with respect to the whole City.*

A *Citizen* peforms the Duty he ows to the *whole City*, whil'st he prefers the Weal and welfare of it, before his own, and desires nothing more, than that it may enjoy full Safety and undisturb'd Happiness. Whilst he chearfully contributes his *Wealth* and *Fortune* for the preservation of it; being ready to expose his Life to mortal dangers for the Defence of it, and to hazard a Part for the Preservation of the Whole. Whilst he omits nothing, that may serve to advance the *Glory* and *Honour* of it, and lays out all the *Strength* of his *Soul* and *Body*, to render it Illustrious and Magnificent.

V. *How he Satisfies his Duty towards his Fellow Citizens.*

A *Citizen* discharageth his *Duty* towards his *Fellow-Citizens*, whilst he behaves himself Kind and Benevolent to all, and makes it his business, to maintain and preserve the exercise of *Peace*, and mutual good *Offices* between them. Whilst he shews himself Affable and Courteous to all, and difficult to *no body*, being always ready to succour, help and assist them, whenever any occasion presents it self, or Necessity requires it. For seeing that the *Laws* of *Cities* are design'd and intended for the common *Good* and advantage, every one promotes his own Interest, whilst he endeavours that of the Publick, and takes the ready way to procure his own welfare and Prosperity, whilst he lays out himself for that of the *Commonwealth*, and every particular Member of it. Wherefore he doth not torment himself, to see the more splendid Fortunes his *Fellow-Citizens* enjoy, nor the high degree of Dignity to which they are exalted, nor that affluence of *Riches* wherewith they abound: But remembring himself to be a Member of the *City*, considers all that to be his own, which he sees the rest of his *Fellow-Citizens* enjoy.

VI. *The special Duties of a Citizen.*

The *Special Duties* are such as belong to every particular *Citizen*, or are peculiar to some only. As to the *first* of these, it is a *Duty* incumbent upon all, that no *Citizen* take upon him any *Publick Office*, or stand for it, but what he is *fit* for, and able to discharge. For what *Man*, that is altogether ignorant of *Chirurgery*, will be so mad as to undertake those Operations, whereon the Life of other *Men* depend? Or where is he, that being altogether ignorant in the *Art* of *Navigation*, will undertake to carry a *Ship* to the *East-Indies*? But the place is offered me, without any of my own seeking. What then, is it to be supposed that others are better acquainted with my abilities than I my self am? A *Blind Man* will never be able to guid and lead the *Blind*, and he who by his presumption, makes himself the cause of the hurt and damage of the whole *Society*, draws the Guilt of *the Publick Ruin upon himself*.

VII. *The Duty of Counsellours.*

Counsellours, and those who with their advice assist the *Rulers* of the *City*, ought to use their utmost diligence, that nothing may be hid from them, that is conducive to the *Good* and welfare of the *City*. They must freely and boldly declare, what they know to be necessary for the safety and flourishing condition of it; but without being byast by any *corrupt* Affections, and without being dazled with the *Fortune* and *Dignity*, mind only the *persons* of those they speak to, lest by flattering their *Rulers* they make themselves vile and contemptible, and by being led aside by their depraved *Affections*, they dishonour and abuse the *Majesty* of their *Function*, and poison and taint the *Minds* of their *Governours*. Let them solicitously keep themselves from being corrupted by *Gifts* and *Bribes*, and shew themselves upon all occasions, as impenetrable and immoveable as a *Wall* of *Brass*, against all the Attacks of the most powerful and insinuating dint of *Mony*. Let them also be the greatest contemners of Pleasure, and being wholly intent on the good and advantage of the *Commonwealth*, prefer the safety and interest thereof, before any of their private concerns.

VIII. *The Duties of Priests or Ministers.*

Those *persons* who are dedicated to the *Service of* GOD and his *Worship*, must above all things take care to lead an *Innocent* and *Holy Life*, and converse amongst their *Parishioners* with all Gravity, always mindful of the Character they are invested with, and that they are taken from amongst *Men*, to transact their concerns with GOD; to be as it were Intercessors with GOD, and *Mediators* to interpose between *Men* and the *Divine Wrath*: That they be careful to avoid all novel *Doctrins*, and never deliver any thing to the *People* that is contrary to sound *Doctrin*, and primitive *Christianity*.

IX. *The Duty of Professors.*

Professors, whose *Duty* it is to teach and instruct others, must take care that their informations be built on good and sound *Principles*, and that with their utmost endeavours they avoid *Falsehood* and *Errors*. Let them also decline the *Perverse Humors* of some, who pretending to be free, and engaged to no Mans Opinion, are ready to teach and defend the most oppositt Opinions, and to blow Hot and Cold from the same Mouth. They must also be very cautious, that they broach no *Opinions* that are inconsistent with the *Peace* of *Society*, or that may occasion any difference betwixt the *Citizens*. Let them also shun all discord amongst

amongst themselves; and consider that they go the ready way to expose the Respect due to their Function, by being divided in their Sentiments, and sowing the *Seeds* of dissension and *Discord* in those places, which should be the seminaries of *Vertue* and ingenious *Literature*. Besides, what credit can be given to their informations, if all that they teach be no better than *Problems*, and where the Affirmative and Negative are equally made void? Wherefore, it is their Duty to neglect all those *Doctrins* and *Opinions*, which are of no use or advantage to the *Commonwealth*, and derogate from the honour due to their *Profession*.

X. *The Duty of Generals or Commanders of Armies.*

Generals, who are entrusted with the *Command* of the *Forces* of the *State*, ought to take care that the *Souldiers* that are listed be strong and vigorous, both as to their *Age* and *Constitution*, and must provide for their being well *exercised* and versed in *Military Discipline*, and to harden them to all *Warlike Labours* and *Difficulties*. As likewise to furnish them with *Arms*, Offensive and Defensive; and above all things provide sufficient *Magazines*, and *Stores* of *Provision* and *Ammunition*, that their Designs may not miscarry for want of these necessaries. They must also have *Spies* at hand, to discover the *condition* and *design* of the *Enemy*, and by this means be able to choose fit occasions to set upon them, or intercept their *Recruits* or *Provisions*. They must also have an *Eye*, that their *Souldiers* be not defrauded of their *Pay*, by the extorsion of the *under Officers*, for otherwise they will never be able to restrain them from *Plundering* and *Robbing*, nor to keep them from Tumultuous Insurrections.

XI. *The Duty of Souldiers.*

The *Duty* of *Souldiers*, on the other hand is, that they be content with their *Pay*, and abstain from *Plundering* and *Spoiling*, or vexatious oppressing of the *Country People*, with whom they are *Quartered*. That they willingly endure the trouble and wearisomness of *Marches*, and the Labours of the *Camp*, considering that they do all this for the good and safety of the *Publick*, wherein their own is included. That they take heed of running *Rashly* and Headlong into dangers; as well as of *Cowardly* declining them, when they are called to face them; that they never stir from the *Post* assigned to them, for the greatest danger, and rather choose to dye Honourably, than to live reproached.

XII. *The Duty of Ambassadors.*

They who are sent to Negotiate the concerns of the *State* to *Forein Courts*, must be persons of a quick *Wit*, and very Circumspect; not easily giving credit to *Rumors*, but being able by their Sagacity to discern vain and false *Reports*, from true and solid; neglecting the talk of the *Common People*, and above all things, taking great heed not to discover any thing, which it is their *Masters* interest should be kept *Secret*. Whilst they are in *Forein Courts*, let them never lend an easy *Ear* to the Suggestions of great Men, and be impenetrable by any thing of Bribe or Corruption.

XIII. *The Duty of Receivers and Treasurers.*

They who are the *Receivers* and *Treasurers* of the *Publick Monies*, must take heed of oppressing the *Subject* in their gathering of it; must not be too exact and rigorous in the levying, or by their *Avarice* extort more from their *Fellows-Citizens*, than is their due to *pay*. When by the Authority of their Superior, they are charged to pay any Sum, that they do it readily, without putting the Expectants to any expence of Time or Mony, before they can receive it. And never defer the payment of any *Salary* or *Reward*, tho' to their greatest *Enemies*, after they have received orders for it.

XIV. *How long Citizens are under the Obligation of these Special Duties.*

All these *Special Duties Citizens* are obliged to perform, as long as they continue in the exercise of those *Functions*, to which they are annext, and from whence they proceed; and cease upon their discontinuance, *viz.* when either the *Officer* is put out of his place, or resigns it, or that the Charge it self be discontinued, as being thought no longer necessary. In like manner the *General Duty* of *Citizen* ceaseth, when leaving the *City*, and setling elsewhere, he ceaseth to be a *Member* of it: Or when for some Crime a person is Banisht from the *Society*; or when being taken *Prisoner* by a *Conqueror*, he is carried away to a strange *Country*.

☞ Fol. 177. for Chap. XXVI. Read XXIV.

The End of the Institution.

THE

THE
SECOND PART,
VIZ.
The History of Nature:
IN NINE PARTS.
Which Illustrates the
INSTITUTION,
And consists of great Variety of
EXPERIMENTS,
Explained by the same
PRINCIPLES.

The

TO THE

Moſt Noble Princeſs,

Frances Tereſa Stuart,

Dutcheſs Dowager of *Richmond* and *Lenox*,
Counteſs of *March*, *Litchfield* and *Darnley*;
Baroneſs of *Leighton*, *Bromſwold*, *Newbury*, *Torbolton* and *Metheuen*:
Lady *Abigny*, and *Grandeſſa* of *Spain*, &c.
Deſcended of the Moſt Illuſtrious and Ancient Family of *Stuart*, and Houſe of *Blantyre* in the Kingdom of *Scotland*.

Madam,

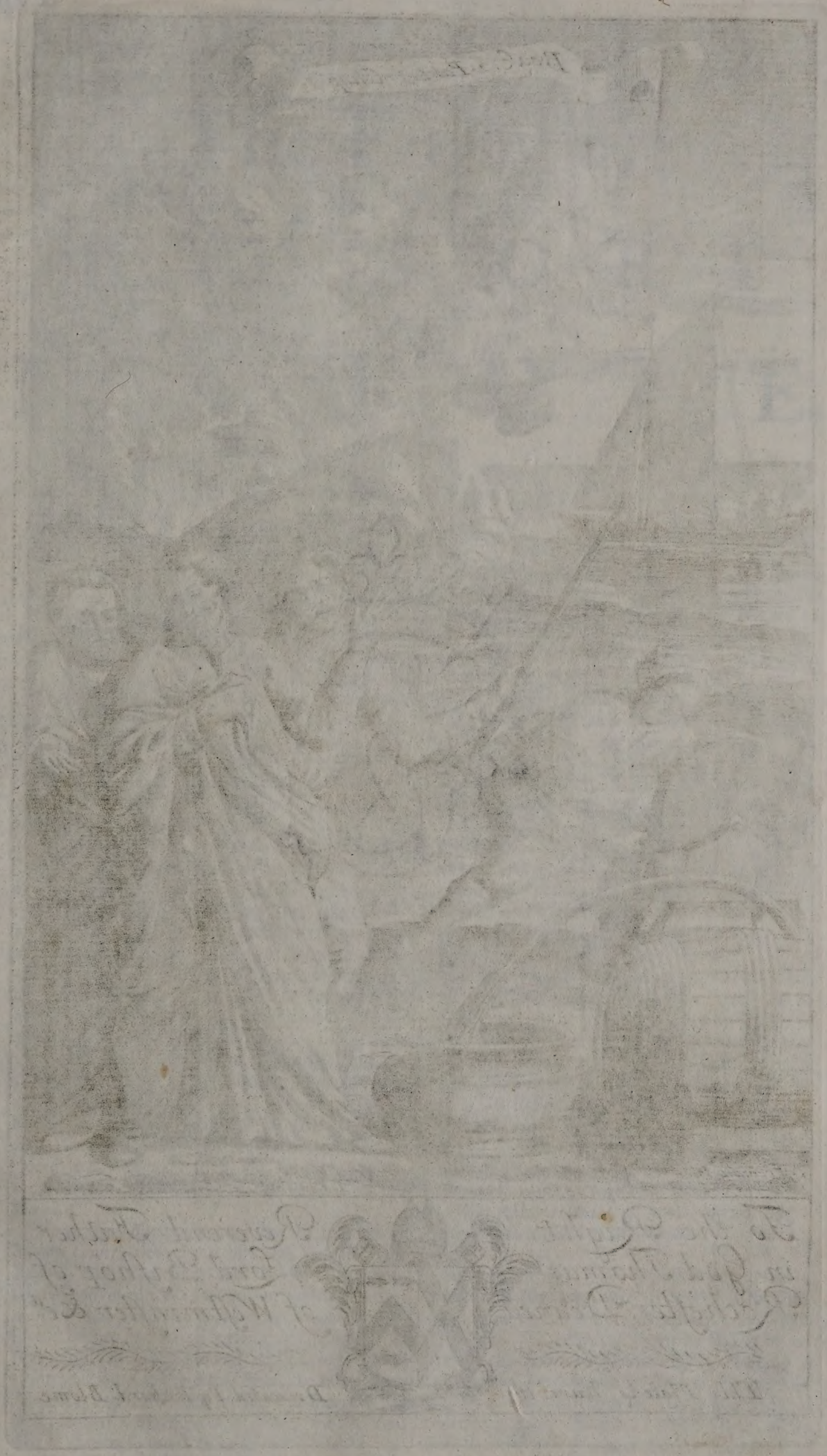
'TIS *the Cuſtom in* EPISTLES DEDICATORY *to make large Encomiums in Praiſe of their* Patron *or* Patroneſs; *I have as Spacious a Field to walk in, and as much to ſay in your due* Praiſe *as any one*; *But having found that all ſuch* Addreſſes (*by your Generous* Soul) *are ſtiled* Flattery, *and declared diſpleaſing to You, I dare not more attempt it: Only* Madam, *give me leave to acknowledge the many* Favours *I have received by your* Encouragement *of my former* Books; *and in acknowledgment thereof, I have taken the boldneſs to ſelect Your* Grace *the* Patroneſs *of this* Treatiſe *of the* HISTORY *of* NATURE, *and ſhall be proud of the* Honour *to have permiſsion to lay it at* Your Graces Feet, *and to be ſtiled,*

Madam,

The Humbleſt of Your Graces Servants,

RICHARD BLOME.

SOLA IUVAT VIRTUS
To the Illustrius Princess
Frances Teresa Stuart Dutchess
Dowager of Richmond and Lenox &c.
This Plate & Treatise of ye History of Nature is most humbly Dedicated by Ric. Blome
G. Freman Inv.
I. Kip Sculp.



To the Right Reverend Father in God Thomas Lord Bishop of Rochester, Deane of Westminster &c.ª

This Plate is humbly Dedicated by Richard Blome.

The First Part OF THE HISTORY OF NATURE. OF BODIES.

CHAP. I.

Of a Body Extended.

I. *The Existence of Bodies is evident to our Senses.*

THO' our *Senses* are often mistaken, and being deluded by false *Representations*, do circumvent our *Mind*; yet have we no safer way by which we may arrive to the Knowledge of *Corporeal things*, than when with their assistance we measure their *Dimensions*, and by *Signs* conveyed through our *Eyes*, discover their *Existence*: For it is by their Advertisements we come to know, that *Matter* consists of 3 *Dimensions*; and that the *Parts* of it are capable of various *motions*, have different *Forms*, and do diversly affect the *Organs* of our *Senses*. For tho', it may be, what is presented to our *Eye*, be only such in outward Appearance, and be represented to us quite otherwise than indeed it is; yet must not we therefore suppose it to be no more than a Phantasm, or some vanishing Appearance, and such as is not to be ranked in the *Catalogue* of *Things*; seeing it is necessary that something that is Bodily, must lye hid under that *shell* or outward Appearance, and which really is the *basis* and *foundation* of the *Figure* we see; tho' because of its distance, or for other Reasons, it may not be perceived such as indeed it is, but takes to it self another Appearance, that it may arrive at the *Organs* of our *Senses*.

II. *The Senses are not deceived, as to the Matter or Subject of things.*

There is no question, but that he to whom a *Square Tower*, viewed at a distance, appears to be *Round*, hath something that is Material or Substantial conveyed unto his *Organ*; since it is impossible that either a *Square* or *Round Figure* should be seen, without any thing to support it, or that might be the *Subject* of it; it being a plain Contradiction, that a *Mode* should be taken from *Matter*, and exist without it: For indeed if we well consider the Nature of a *Mode*, we shall find that it cannot so much as be in our Thought conceiv'd as separated from it. For tho' we can have a clear perception of *Substance*, whether *Material* or *Immaterial*, without their *Modes*; yet by no means can we conceive those *Modes*, without the said *Substances*, since it is their very Nature to affect and diversifie *Substances*.

III. *The Opinion of the Ancients about the Nature of a Body.*

Wherefore the *Ancient Philosophers* did demonstrate, that a *Body* consists of a concurrence of *Figure*, *Magnitude* and *Resistance*; because they found nothing but *Matter was extended in Length, Depth and Breadth*; nor any other thing besides it, that could not abide its like in the same place with it, but pusheth it thence, and excludes *Penetration*. For herein do *Material Substances* differ from *Spiritual*, because the former fall under our *Senses*, carry a bulk with them, and are subject to the *Touch*. By the word *Touch*, we do not only understand the *Sense* so called, which is peculiar to *Animals*, and whereby they feel *External Bodies*; but that more general, whereby 2 *Bodies* touch one another with their *Surfaces*, and whereby they are intimately close to one another. For it is the property of *Material things* only, to *touch* and be *touched*, and to be joyned together by a kind of middle *Term*; which is so evident, that it cannot be question'd by any that either make use of their *Imagination*, or perceive any thing by the *Senses*: As LUCRETIUS in his *First Book* tells us,

That Bodies are, we all from Sense receive,
Whose Notice, if in this we disbelieve,
On what can Reason fix, on what rely?
What Rule the Truth of her Deductions try,
In greater Secrets of Philosophy?

IV. *How a Spirit is said to be extended.*

But some it may be will object here, that a *Spirit* also is *Extended*, and yet is is excluded from participating of the Nature of a *Body*. To which I Answer, That when a *Spirit* is said to be *extended*, this is not to be understood according to the threefold *dimension* of *Bodies*, which we imagine; but with respect to its Power and Energy, whereby a *Spirit* diffuseth its active Force, sometimes through a larger, and at other times through a lesser part of the *Bodily Substance*; so that in case there was no *Body* or *Space*, a *Spirit* could

never be understood to be *extended*, that is, to have, or correspond with any dimensions.

V. *Whether there be any Vacuities in Bodies.* The only *difficulty* that remains to be resolved, is, whether besides the *Bodies*, whose Nature, we have said, doth consist in Extension, there be any *Vacuity* in *Nature*, destitute of all *Matter*, which yet enjoys the properties of *Longitude*, *Latitude* and *Profundity*. GASSENDUS, who hath made it his business to restore the *Doctrin* of EPICURUS, and hath made himself Famous by raking these *Emptinesses* out of the *Darkness*, wherein they had for many Ages been buried, in his *Animadversions* upon the *Tenth Book* of LAERTIUS, concerning EPICURUS his *Physiology*, doth both by *Reasons* and *Experiments* endeavour to prove, that there are *empty Spaces* in the *World*; which tho' they do not actually contain any *Body*, yet are so dispersed amongst *Bodies*, as to be ready to admit *Bodies* and contain them. Much after the same manner, as a *Vessel* is said to be *Empty*, when it is destitute of any *Liquor*, which yet it is capable of receiving. For if this *Liquor* chance to be emptied out of the *Vessel*, the inward Surface of the *Vessel*, which before contained the *Liquor*, must needs remain *empty*; except some other foreign Matter come in to fill up its sides, and be commensurate to the Dimensions of the *Body* that fill'd it before. He confirms his Opinion by the Example of a *Heap* of *Wheat*, betwixt the *grains* whereof many *little spaces* intervene, which are not taken up by them, forasmuch as their *Surfaces* appear to the *Eye*, to be distant from each other, it being impossible they should lye so close together, but that they must leave some *Intervals* destitute of any *Bodily Substance*.

VI. *A Physical, and a Mathematical Body do not differ.* But GASSENDUS doth not seem, in this his Assertion, to have warily enough consider'd the Nature of a *Body*, which doth not only consist in a *Physical* or *Natural*, but also in a *Mathematical Extension*; and which is of that intimacy to it, that it cannot so much as in Thought be separated from it. So that *Extension* is Reciprocal with a *Body*; and as there is no *Body* which doth not consist in *Length*, *Breadth* and *Depth*; so there is nothing commensurate to those 3 *Dimensions*, but hath also the Nature of a *Body*.

VII. *The Distance that is between Bodies, or the parts of a Body, do not prove a* Vacuum. But some will say, We find *little Spaces* betwixt the *particles* of *Bodies*, which because of the diversity of their *Sides* cannot be filled up by them. I grant it; but will it follow from thence, that those *Intervals* or *Spaces* must therefore be Empty, or destitute of any *Bodily matter?* For why may they not be fill'd with *Air*, or some other Matter more subtil than it? For if the said Parts be distant from each other, and take up *different places*, how can they be conceived to be distant, or truly said to be so, by means of an Empty interval? Seeing that according to that Saying amongst *Naturalists*, *Something must always intervene between those things that are distant.* For, seeing that *Distance*, which cannot be found but between things more than one, is a kind of *Relation*; and that every such must have a Foundation, it is necessary that the said Relation rest on a real *ground* or *basis*: Forasmuch as *a Non-entity hath neither Affections nor Operations*; and consequently, that which is Nothing can never constitute the Distance of *Bodies*.

VIII. *Possible Repletion is not sufficient to constitute Distance.* Neither must we assert with some, that *Distance* is founded in the *Bodies* themselves, that are distanc'd from each other, and that *Possible Repletion* is sufficient to constitute it. For from this Supposition we might lawfully infer, that they are at a Distance from one another, which way soever they are posited or disposed, seeing that the same *Foundations* do still remain, whether they be distant, or touch one another. Wherefore *Distance* must be assigned to something that is different from the *Bodies* themselves; which seeing it cannot be *Immaterial*, for that it is unextended, we must have recourse to something *Corporeal* that must be the Cause of it.

IX. *Extension is that which constitutes Material Substances.* I know very well, that some *Philosophers* do not approve of our assigning triple *Dimension* to be a *Substance*; they looking upon it to be no more than a *Mode*, or *Accident*. For who doth not consider the *Extension* of a *Stick*, to be only a *Mode* of it, and that the *Stick* is the *Subject* or Substance which supports it? But it will be easie to shew, that this *Error* is only deriv'd from our common way of expressing our selves; and that it is every whit as absur'd to assert it, as if a Man, hearing some speak of the *Royal Palace*, should imagine these 2 words to mean 2 things, and that one of them was a *Mode* of the other. But to the end, that all the difficulty we meet with in this business may be cleared out of the way, we shall only take notice, that such is the Nature of a *Substance*, that it can exist without a *Mode*; whereas a *Mode*, on the contrary, doth so depend upon *Substance*, that it cannot exist without it. Now it is apparent, that the *Extension* in a *Stick*, can be without a *Stick*, seeing that there are many *Bodies* that have not the Form of a *Stick*, which notwithstanding have Extension; but there can be no *Stick*, which is not *extended*. And therefore it is so far from this, that *Extension* can be said to be the *mode* of a *Stick*; that we must rather conclude, that *Extension* deserves the Name of *Substance*, and that the Being of a *Stick* is only the Mode of it.

X. *Nothing that is Indivisible can be conceived to be in a Body.* Hence it is apparent how foolishly they Talk, who consider *Mathematical Points* in an Extended *Substance*, and will needs have the divisibility of it to be bounded by an indivisible Term or Boundary. For if in any *Line*, by *division* we come to the last Indivisible; that being once taken away, if you divide the other Parts after the same manner, you will at last come to the like indivisible or unextended *Terms*; and afterwards having made a like *division* of all the rest, you will find nothing else in this *extended Line*, but *Indivisible* or *Mathematical Points*: Which is not only contrary to *Reason*, but also destroys the Notion we frame of *Extended Beings*.

XI. *An Objection of the* Epicureans. But the *Epicureans* will Object, That the last *Resolution* of *Natural Compounds*, is into the least *Natural Bodies* or *Atoms*; for that otherwise every *Body* would be divisible into *Infinite*, which they suppose to be an Absurdity. For that every thing which is *Divisible*, can only be divided into those Parts, which are *actually* in it; and consequently, that if *Bodies* be infinitely divisible, they must have *actually* infinite Parts: And so all *Bodies* will be actually infinite in their Extension, which no Man in his Wits will undertake to assert.

I intend

XII. *A Physical Atom, or least Body, is divisible, because it consists of Parts.*

I intend to give a full Answer to this Objection, in the *Fourth Chapter*; but shall here demand of these Defenders of EPICURUS, whether an *Atom*, which they contend is Indivisible, have any *parts*; or whether it be destitute of all *parts*, and consequently of *Extension*? If they affirm the latter, then their *Atom* doth not differ from a *Mathematical Atom*. If they affirm the former (for it cannot be denied, seeing that every *Atom* is endued with triple Dimension, and hath its particular *Figure*) it is obvious to enquire, whether the parts of an *Atom* consist of other less parts, and so on to Infinity; or whether at last we must come to the least parts, which admit of no further *Division*. If they maintain this, they embrace the Opinion of ZENO, and so will be bound to maintain and defend a *Mathematical*, and not a *Physical Atom*, which indeed is no better than a meer *Fiction*; but if they chuse rather to maintain the other, there is nothing in *Bodies* that is altogether indivisible, nor any *Atom*, whether it be called *Mathematical* or *Physical*.

XIII. *GOD can divide a Physical Atom.*

Besides, an *Atom* cannot be conceived to have a *Figure*, and several *Angles* really and intrinsecally different from each other; for if so, it could not be *Indivisible*, and consequently no *Atom*. For is it not evident, that all those things that can be conceived by different *Idea's*, and that have a real independent Existence, can also be divided and separated from each other? And cannot the Infinite Power of *GOD*, at least, do as much as our Finite Intellect can conceive? Now our Understanding can conceive 2 *Angles* of the same *Atom* under several Notions, and know one of them without knowing the other; and conceives also that several *Angles* of the same *Atom* do subsist independently of each other; and therefore it is not to be question'd, but that *GOD*, by his *Omnipotence*, can separate these *Angles* from each other.

CHAP. II.

The Arguments of EPICURUS *Answer'd, whereby he endeavours to prove, That there are empty Spaces interspersed between Bodies.*

I. *The Rest, or Motion of Bodies, does not require an Empty Space.*

EPICURUS, who confounds *Place* with a *Vacuum* or *Empty Space*, and supposeth that all *Bodies* have their residence in those *Vacuities*, is of Opinion, That except there were such, *Bodies would have no places to exist or move in.* For since a *Place* is commensurate to the thing placed, and the hollow *Surface* of that, must be equal to the outward *Surface* of this: As also, that *Place* is accounted *Immoveable*, and that it is repugnant for it to be removed from its position; it follows that *Place* must always continue the same, even after that the *Body*, which fill'd it before, is removed elsewhere, and successively takes up other Places; and that therefore it is necessary, that the same be left *Empty*, and do preserve its Parts immoveable.

II. *Bodies, where they come, bring their places along with them, and upon their Removal take them away.*

But EPICURUS was mistaken, in that he supposed a *Place* to be a *Space* subsisting of it self, which is equal to the *Body* placed, in *Magnitude*, and really distinct from it: For if we precisely have regard to the Notion of a *Place*, we shall find it to be nothing else, but a certain *Respect* of the Situation of a *Body*, to the Neighbouring *Bodies* about it; or to others more Remote, from whence it takes its immobility. So that to say a thing is in a *Place*, or acquires a new *Place*, is no more than to say, that it attains or acquires such a Situation, with respect to other *Bodies*. And it is a meer Mistake of the *Mind*, to imagine a *Place* to be a certain *Capacity* or *Interval*, which *Bodies* enter into, and leave again; forasmuch as *Bodies* do indeed bring their *places* along with them, and upon their Removal take them away again. And therefore we say, that a *Body* takes up some *space*, forasmuch as it is of such a Bulk amongst the other parts of the *Universe*, and is ranked amongst *Material things*: And that it quits a *place*, when it ceaseth to keep its *Magnitude*, *Figure* and *Situation* between such and such determinate *Bodies*.

III. *Whether there can be any Motion, without allowing an Empty space.*

Another Argument, whereby EPICURUS endeavours to establish a *Vacuum*, is taken from the Nature of *Motion*. If, saith he, there be no *Empty space* in *Nature*, neither is it possible that there should be any *motion*; and consequently the whole *Universe* would be nothing else, but a *stiff immoveable Mass*, and unable to admit any *Bodies* into it self. For supposing all *Spaces* to be full, a *Body* will be incapable of removing it self from one *place* to another, but by thrusting another out of its *place*; so that if we suppose any *Body* to be moved, it must of necessity thrust another, at least of *equal bigness* with it self, out of its place; and that also must do as much for another, and so it will be necessary to allow a Process to *Infinity*, except that some *Empty spaces* be allowed, into which the *Bodies* that are in *Motion* may enter, and, as it were, take up new *Lodgings*.

IV. *In every Motion, a whole Circle of Bodies moves together.*

This Argument of EPICURUS might be of some force, if there were no other *motion*, but that which is made in a *Strait Line*; and if when one part of the Matter is moved, the other following were moved for ever; but *daily Experience* teacheth us the contrary, and that indeed there is another Motion, that is, a *Circular*, by which a *Body*, when it is made, doth drive another out of its place, and that again another and another, till it come to the last *Body*, which enters the place of the *Body* that was first moved. Now this *Circle* can be performed without the supposal of any *Vacuum*. As suppose we the hollow *Circle* X Y Z, fill'd with 12 *Bullets*, whilst the first of them A moves, it pusheth on the second B, and that the third, till by continual pushing, the place which was left by the first *Bullet*, be fill'd by the last *Bullet* C. And thus we see how *motion* may be without granting any *Empty space*, to which *Bodies* might betake themselves.

Figure 1.

V. *An Objection against the Circular motion of Bodies.*

If you Object with GASSENDUS, that the *Bullet* A cannot move, except the twelfth *Bullet* C be moved also; and that C cannot move, because, in order to its *motion*, it is necessary that A do possess the place of B, which as yet is not conceived to be *empty*, and that therefore as long as B continues unmoved, neither can A be moved; and that consequently all the *Bullets* contained in the *Circle* will continue unmoved.

VI. *The Objection Answer'd.*

I Answer, That this Objection of GASSENDUS is built upon a false *Supposition*, whilst he imagins that the *Bullet* C cannot move, except there be some *Empty space* whereto it might betake it self, when it begins to move; since it may so happen, that at the same *moment* when A enters the place of B, C may leave its former place; so that whilst the *Bullet* A passeth towards B, it pusheth B forwards, and B that which is next to it, &c. unto C, which at the same instant enters the place left by A.

The thing will be more evident in a *Grind-stone*, or in an *Iron Circle*, which is moved about its own *Center*; for since every part of it doth at the same instant possess the place which is quitted by the fore-going, we see there is no necessity to have recourse to a *Vacuity*. For if this may be done in an *Iron Circle*, why may it not as well be done in another, partly consisting of *Wood*, and partly of *Air*? Why may not the *Body* A, which we suppose to be *Wooden*, push the *Body* B, which is *Airy*, out of its place, and B again that which is next to it, and that again another till it come to C, which will take up the place of A, at the very same time that A quits it? The same may be illustrated by the *Circling* of the *Water* about a *Ship* under Sail.

VII *Why Water sometimes mounts upwards.*

Accordingly we find, that as much *Liquor* as runs out of any *Vessel*, so much *Air* must of necessity enter into it; and except there be an open vent for the *Air* to enter, it will be in vain to endeavour to draw the *Liquor* out of the *Vessel*; because wherever this *Circular motion* is hindred, it is impossible for a *Body* to remove out of its place. Thus when the *Air* is drawn out of a *Pipe*, the other end whereof stands in the *Water*, the *Water* immediately mounts upwards, notwithstanding that that *motion* is contrary to its Gravity.

VIII. *All Bodies move together, tho' it be in an Unequal Circle.*

And that it happens thus in every *Circle*, is easie enough to be conceived, especially where this *Circle* is supposed to be perfect, so that all its Parts are at an equal distance from the *Center*. But the same doth not seem to happen where the *Circle* is unequal, and whose *Spaces* are different in breadth and narrowness, as appears in the *Circle* E F G H. But this Difficulty is easily solved, if it be consider'd that all these *Inequalities* may be compensated or made up by swiftness of *motion*. For suppose we the *Space* G to be 4 times broader than the *Space* E, and double as broad as the *Space* F and H, it must necessarily follow that the matter must move 4 times more swiftly at E, than at G, and twice as swift at F and H; and thus, because the swiftness of the *motion* makes amends for the narrowness of the *place*, there will in the same Space of Time as much Matter pass through one part of the said *Circle*, as through the other: So that there is no necessity at all to feign *Empty spaces*, or to admit of *Condensation*.

Figure 2.

IX. *It is not necessary, that all Motion should be Circular.*

But when we say that *Bodies* move in a *Circle*, we must not be so understood, as if we suppos'd that all *motions* were either Oval, or perfectly Circular; but only that they are called *Circular*, because the last *Body* which is moved by the impulse of another, doth immediately touch the First Mover; tho' the *Line* which is described by all the *Bodies* that are moved, by the *motion* of that one *Body*, be very crooked and irregular.

From what hath been said, an account may be given of that Experiment so common with *Boys*, *viz.* how it comes to pass that a little round piece of *Leather* is able to lift up a great *Stone*; the Reason whereof is, because the *Stone* A, hanging on the *String* B, by means of the *Leather* C, to which it cleaves or sticks fast, cannot fall down from the *Leather*, without the *Air* that is under the *Stone* be first driven out of its place, and come into the place of the *Stone*, under the round bit of *Leather*: But forasmuch as before the *Stone* can fall down from the *Leather*, there must be a *slit* or opening between the *Stone* and the *Leather*, before there comes to be a greater *Interval* between them, capable to receive or admit the *Air*, as being thicker and more expanded, because of the intercurrent *Æthereal Matter*; it so happens, that because the Circle of *Bodies* is hindred, the *Stone* of necessity must stick so long to the *Leather*, till the *Air* be driven away from under the *Stone*, and get in betwixt the *Leather* and the *Stone*.

X. *How it comes to pass, that a little round piece of Leather wetted, is able to lift up an heavy Stone.*

Figure 3.

The Difficulty we have to conceive the *motion* of *Bodies* where there is no *Vacuum*, proceeds from a Supposition we have taken in, that *GOD* at the Beginning divided *Matter* into *Equal parts*, *Round*, *Square*, *Triangular*, *&c.* According to which Conceit, we cannot imagine how possibly they could move, without leaving *Empty spaces* between them. And indeed, granting this Supposition, it could not be otherwise: But indeed we must go upon a quite contrary *Hypothesis*, and conceive that *GOD* at the Beginning, divided the Matter into *Unequal parts*, infinitely differing in *Bulk* and *Figure*; which suppos'd, it will be easie to comprehend that a *Body* may move where there is no *Vacuum*, but all full of *Bodies*, as well as in a *Vacuum*; for let it be *Square*, *Round*, *Oval*, or of any other *Figure* whatsoever, the *Spaces* which are between it, and the *Bodies* that surround it, will not be empty, because there will be always *Particles* of Matter *Subtil* enough for to enter and fill them, and besides will be endued with sufficient agitation to break them; and by breaking of them, reduce them to *Figures* proper to fill the places they are to enter.

XI. *Whence the Difficulty we have to conceive the Motion of Bodies, in a Space full of Bodies doth arise.*

CHAP. III.

GASSENDUS his Experiments examined, whereby he endeavours to prove, that there are Vacuities in Bodies.

I. *Gassendus, his Experiment drawn from a Wind-Gun, to prove a Vacuum.*

THere is no question, but that *Experiments* are the best Proofs of *Philosophical Truth*, and that those *Principles* are most likely to be *true*, which are built and founded upon *Natural Phænomena*, and have them to be the *Witnesses* of their Evidence. And therefore it is that GASSENDUS endeavours to prove the *Existence* of *Empty Intervals* in the *World*, by *Arguments* drawn from *Condensation* and *Rarefaction*. Suppose, saith he, a *Wind-Gun*, and that the *Bore* that contains the *Air* is of the length of 2 *Fingers*; there is no question, but that as much of the *Air* is therein contained (if no Empty Spaces be interspersed between the Parts of the *Air*) as the place, or capacity of the *Bore* is able to contain; so that there is no part of the place so little, to which a part of *Air*, of equal Bigness, doth not answer, and consequently

sequently the parts of both must be equal in Number.

II. *It is repugnant for one and the same Body to be in more places at the same time.*

Suppose also this Number to be 1000, then let the *Air* be compressed with an *Instrument* fit for that purpose, and by that means be reduced to the measure of a *Fingers* length only. What order will these parts of *Air* afterwards keep, when at that time, of the parts of Place, there are not above 500 left? Or shall we suppose that 2 *Bodies* are crouded into one and the same place? This is repugnant to the *Laws* of *Nature*, since *Impenetrability* is the Property of a *Body*; and it is as much a Contradiction for 2 *Bodies* to be in the same place, as for 1 *Body* to be in divers places. Wherefore if the *Particles* of *Air*, contained in the *Bore* of the *Wind-Gun*, be shut up in a more narrow place, it is necessary that their *Sides* and *Angles* should be more closely lodg'd, and fill up the Intercepted *Empty spaces*; which being once fill'd, it cannot be thought strange, if by this means the Interval be made so much the lesser, and less protuberant than it was before.

III. *The true Reason of this Experiment given.*

But GASSENDUS in alledging this *Experiment*, doth not seem to have heeded the Proceedings of *Nature*; for tho' naturally *Penetration* be repugnant to *Bodies*, yet must not we inferr from thence, that there are *Empty spaces* in *Bodies*, which may receive the ambient *Air*, or contain any other *Matter*; seeing that it is very possible, that amongst the *thicker* parts of *Air*, there may be some more *Subtil matter*, which coming forth from the Pores of *Bodies*, may make that the Space which seems to be fill'd, may admit other *Air*. Because the *Air* that is thrust in by force, doth drive out the *Subtil matter*; which giving way to it, doth break forth through the *Pores* of the *Gun*. Wherefore the *Compression* of the *Aiery parts* doth not proceed from the filling of the *Empty spaces*, but from the Expulsion of the *Subtil matter*, which gives way to the parts of *Air*; whilst they come nearer together, and either make the *Pores* less, or quite take them away.

IV. *From the Nature of a Body.*

For this is a *Consequence* which is deduced from the Nature of a *Body* or *Matter*, that when a *Body* appears under a *less* Bulk than it seemed to be of before, tho' it doth not appear that any part hath been taken away from it; we must conceive that some very *Subtil matter* is come forth from the *Pores* of that *Body*, and thereby have made the Parts come closer together, and reduced the whole *Body* to a *less* compass.

V. *What an Æolipile is.*

The next *Experiment* produc'd by GASSENDUS, is that of an *Æolipole*, which is an *Instrument* made of *Copper*, or of some other *Metal*; the whole hollow whereof is at first fill'd with nothing but *Air*, which becomes so dilated by being set near to the *Fire*, that the greatest part of it, breaks forth from it through the Hole D, which *Hole* is afterwards plung'd into a Vessel full of *Water*; and as the *Air* of the *Æolipile* becomes condensed again by the Coldness of the *Water*, the *Water* riseth to fill it. This being done, care is taken so to place the *Æolipile*, as that the lower part of it may rest upon glowing *Coals*, which causeth the *Water* that is contain'd in it to be rarefied into *Vapours*, the first whereof being push'd on by those that follow them, make their escape together with the *Air* through the said Hole D, with so much swiftness, that they produce a very sensible *Wind*, which continues to blow continually, till all the *Water* be evaporated, or that the Heat do cease to rarefie the *Water* into *Vapours*.

Figure 50. *in the Institution.*

VI. *The second Exptriment of* Gassendus *against a* Vacuum, *fetch'd from an* Æolipile.

Let us suppose therefore the *Æolipile* A B C D E, and one part of it A B C, to be fill'd with *Water*, and the other A E C with *Air*: Now the Enquiry is, how it can be, that tho' the *Water* which is contained in this Vessel being rarefied by the *Fire*, do break forth with great violence through the Hole of it; yet the whole hollow of the *Æolipile*, doth still continue as full of *Matter* as it was before. For if the parts of *Air* A E C, and the parts of *Water* A B C, were equal in number before the *Æolipile* A B C D E, was put near the *Fire* to be heated; the remaining parts, after that some of them have been evaporated, must needs take up more place: And therefore like as a *Heap of Dust* being tost'd with the *Wind*, becomes diffused and spread abroad like a great *Cloud*, because of the *Air* that is intermixt with the *particles* of *Dust*, why may not the *particles* of the *Air* and *Water* contain'd in the *Æolipile*, being put into agitation by the little *Bodies* that have been introduc'd, take up the whole Space, which before was taken up by the interspersed *Vacuities*?

VII. *The Experiment of the* Æolipile *explained.*

But to this I answer, that there is no Consequence in all this, because the parts of *Water* A B C, contain'd in the *Æolipile*, are not therefore dilated, because they take up the Empty Spaces, which before were intermixt with the parts of *Air* A E C; but only because the *Æolipile* being set upon the *Fire*, the heat thereof sets the *particles* of the *Water* in *motion*, and makes them to push against each other, and with great striving endeavour to get further from each other. For the *Subtil matter*, which hath been introduced by means of the *Fire*, doth distend and dilate their *Pores*; so that such as are more closely compressed, and do strive to disentangle themselves, break forth with violence through the *Hole* D, towards F, and resemble the Blast of *Natural Wind*. Wherefore the Dilatation of the *Water*, upon the *Surface* A C, is only to be attributed to the *Subtil matter*, which is entred through the *pores* of the *Æolipile*, which agitating the *particles* thereof, doth not permit them any longer to hang together; according as GASSENDUS himself doth acknowledge in these Words; *And this by the Activity of the particles of Fire, which being entred into, and most swiftly tossed between the Sides of the Æolipile, do not suffer the Parts of the Water to rest; but drives them up and down, this way and that way, so as that they seem to fill the whole Space.*

VIII. *A third Experiment fetch'd from the Dissolution of Salts.*

There is yet another *Experiment* whereby GASSENDUS supposeth that *Vacuities* are certainly proved: For he considering that a determinate quantity of *Salt* only could be dissolved in such a Measure of *VVater*, and that having taken in as much as it can, it leaves the rest of the *Salt* undissolved; this he thinks cannot be solved any other way, than that the *Salt* being separated into very small *particles*, doth every way penetrate the *VVater*, and fill the Empty Spaces that are in it; which being done, the further dissolution ceaseth in the same manner, as a *Stomach* that is already glutted with *Food*, doth cast up whatsoever is superadded. And foraſmuch as the *Particles* of *Salt* are not all of one *Figure*; for those of *Common Salt*

are *Cubical* or *Four-ſquare*, thoſe of *Alom* 8 Corner'd, &c. Spaces of a different *Figure* muſt be aſſigned to them; and that there are ſuch, may be eaſily proved, becauſe *VVater* already impregnated with common *Salt*, doth notwithſtanding afterwards diſſolve and take in *Alom*, *Salt Armoniack* and *Sugar*. Which admiſſion of ſeveral *Bodies*, cannot be imputed to any other Cauſe, but thoſe *Empty ſpaces* which are between the parts of the *VVater*; becauſe when they are once fill'd up, the *VVater* can diſſolve no more of theſe *Salts*, as having no *Vacuities* where to beſtow them.

IX. *How Salt is diſſolv'd in Water.*

This *Experiment* would be of ſome ſervice to GASSENDUS, if he could perſuade us, that the Bulk of the *VVater* is not at all increaſed by the diſſolving of *Salt*, and that it takes up the ſame Space it did before; whereas indeed daily Experience teacheth us the contrary. For tho' in a *Cup* full of *VVater*, a certain quantity of *Salt* may be diſſolved, without ſpilling any of it, yet not without ſome ſpreading of its *Surface*: For it is evident, that by the putting of *Salt* or *Aſhes* into *VVater*, the Surface thereof *ſwells*, and jets out in the midſt, in the manner of a *Globe*. As may beſeen in a *VVeather-Glaſs*, or *Glaſs-Pipe*, into which if any *Salt* be infuſed, the *VVater* preſently increaſeth and mounts higher.

X. *Why a certain and determinate quantity of Water, can diſſolve a certain quantity of Salt only.*

But you'l ſay, If there be no *Vacuities* in the *VVater* to admit the *particles* of *Salt*, how comes it to paſs that it is ſatiated with a certain quantity of it, and rejects all the reſt? This may eaſily be anſwer'd, by ſuppoſing that the parts of *Salt* are *ſtiff* and *inflexible*, whereof thoſe of *freſh Water* are very *ſoft* and *flexible*. For when the parts of *Salt* lye athwart one another, they give occaſion to the parts of the *freſh VVater* to run or ſlide between them, and like Rings to encompaſs them round, and to diſpoſe them ſo that they may the more eaſily glide between them, and continue their *motion*, than if they were all alone. For the parts of *VVater* being entangled with the parts of *Salt*, the *Subtil matter*, by whoſe force they are agitated, have no other buſineſs, but to carry them ſwiftly round the *particles* of *Salt*, which they embrace. Whereas, when they are alone, and conſtitute the *freſh VVater*, they are ſo confounded together, that the *Subtil matter* is forced to employ part of its ſtrength, in variouſly bending and plying of them; ſeeing that without the impulſe thereof, they continue immoveable, and cannot be ſeparated from each other. Foraſmuch therefore as the *parts* of *freſh VVater* are finite, and that the virtue they have to move themſelves is *limited*, it muſt neceſſarily happen that after they have encompaſt a certain number of the *parts* of *Salt*, they will not be able to overcome the reſiſtance of the reſt; and therefore the *VVater* being as it were *ſatiated*, will not be able to diſſolve the ſuperadded *Salt*; becauſe there are no more flexible parts of the *Water*, to ſurround or embrace the *particles* of *Salt*, by winding of themſelves round about them, and by that means cauſe a liquefaction of them. This is manifeſt in *Common-water* and *Aqua-fortis*, which can only diſſolve a determinate quantity of *Salt* or *Metal*; ſo that if after they have received this proportion, if one ſhould but caſt in over and above one grain of *Salt*, it will remain as much indiſſolved, as if it was laid up in a dry place.

XI. *The Reaſon of all Cryſtallizations.*

And for this *Reaſon* it is, that *hot Water* that hath run through *Nitrous Earth*, and thereby become a *Lye*, by having taken in a quantity of *Nitre*, being removed from the *Fire*, and let reſt for ſome time, many of the *Atoms* of *Nitre*, ſeparated from the reſt, begin to ceaſe from *motion*, and ſticking to the inward Sides of the *Veſſel*, do conſtitute the wonderful 6 *Corner'd Bodies*; whence we may eaſily apprehend all the *Cryſtallizations* of the *Chymiſts*, and how they are done.

XII. *The fourth Experiment, of a Pipe of Glaſs, fill'd with a certain proportion of Quickſilver.*

It remains now only, that we endeavour to aſſign the Reaſon of that *Experiment*, which TORRICELLIUS made at *Florence*, as GASSENDUS informs us; which take as follows: Having taken a *Glaſs-pipe* of 3 Foot long (according to the deſcription of it in the 17*th Chapter* of the 5*th Part* of our *Philoſophical Inſtitution*) 7 *Fingers* breadth, and 9 *Inches* long, fill'd with *Quickſilver*, and having ſtopt the Mouth of it with his *Finger*, he dipt it into a *Veſſel* with *Quickſilver*, and then found that upon taking away of his *Finger*, all the *Quickſilver* did not run out of the *Pipe* into the *Veſſel*, but continued in the *Pipe* to the height of 2 *Foot* and almoſt 3 *Fingers* breadth, after having made ſome Vibrations upwards and downwards, and in the mean time leaving the upper part of the *Pipe*, not only deſtitute of *Quickſilver*, but of any other *Body* whatſoever.

XIII. *The true Reaſon of the foreſaid Experiment.*

This *Experiment*, tho' it be highly eſteemed by ſome, as that which ſeems manifeſtly to evince a *Vacuum*; yet is it of no account with thoſe who admit *pores* in *Bodies*, which are penetrable by the *Subtil matter*, and take up thoſe places which are quitted by *Groſſer Bodies*. For ſuch is the Nature of the *Matter* of the *Firſt Element*, that it doth not only pierce *Glaſs*, but even *Diamonds* and *Steel* it ſelf, and any other *hard Bodies* whatſoever. For tho' *Glaſs* may ſeem to be deſtitute of *Pores*, yet it cannot be queſtion'd but that it is endued with continual *Pores*, without any interruption; which is evident from its *Tranſparency*. For when it is in *fuſion* and *liquid*, the *Subtil matter* flowing around all its parts, doth form innumerable *pores* in them, through which the *Globuli* of the *ſecond Element* do enter, and diffuſe the Action of *Light* every where. Where tho' that Space in the *Pipe*, which is relinquiſh'd by the *Quickſilver*, ſeems to be Empty; yet nothing hinders, but that it may be fill'd with ſome very *Subtil matter*, which is not ſubject to our *Sight*. Neither was GASSENDUS ignorant of this, who in his Explication of this *Experiment* doth allow, that *the Bodies of Heat and Cold can penetrate into the Hollow of the Pipe*. And he holds the ſame concerning the *Light*, which he owns to be a *Corporeal Subſtance*, and a very thin and *Subtil matter* which paſſeth through the Sides of the *Glaſs*. Wherefore it is without all Reaſon, that from hence he endeavours to prove *Empty ſpaces*, ſeeing that in thoſe Intervals that are fill'd with *Subtil matter*, there is as much room to admit other *Bodies*, as if it were altogether empty, and without any *Body* at all in them.

XIV. *That there is no Vacuity in the Glaſs-Pipe.*

Moreover who doth not know, that *Nothing* is not capable of any *Properties*; but if *Fire* be apply'd to the upper part of the *Pipe*, we ſhall find a like *Rarefaction* to be produc'd there, as we perceive in the *Weather Glaſs*, and by means whereof the *Quickſilver* is driven downwards. When it is very clear, that there is ſome true *Matter* there, which is the Subject of this mutation.

Now

XV. *How the Existence of such a Subtil Matter may be proved.*

Now such a *Matter* as is much more subtil than *Air*, not only PLATO and ARISTOTLE, but all the ancient *Philosophers* have owned; which enters the *pores* of all *Bodies*, and intimately insinuates it self into them: For by means hereof the *Juices*, which during the *Winter season* the *Earth* conceals in her Bosom, being agitated upon the approach of the *Spring*, do pierce the *pores* of *Plants* and *Seeds*; but after that the too great increase of *Heat* hath more dilated the *Pores*, or that the *Cold* hath overmuch straitned them; then the *Juice* either passeth directly through them, or by reason of the narrowness of the *Pores*, cannot enter them at all; and consequently the *Seeds* or *Plants* must dye. So that in the whole *Vegetation* of *Plants*, we meet with nothing, but a *motion* derived from this *Subtil matter*, and proceeding according to certain Rules: So likewise it is an effect of this *Subtil matter*, that *Glass* taken out of the *Furnace*, and set in a Cold place, presently breaks to shivers, because the *Pores* of the outward Parts are sooner shut up by the *Cold*, than those which are more inward; and therefore the greater parts of the *Subtil matter* that are shut up in them, hinder the Egress of the rest. Neither probably is there any other Reason to be assigned, why *Glasses* break of themselves. And to this we may likewise add, that it is from this *Subtil Æther*, that *fluid Bodies* are enabled to preserve their Mobility, and do presently corrupt, whenever their *motion* is disturbed or interrupted: For the principal Office of this *Substance* is, to dispose and incline the Parts of *Bodies*, and more especially such as are *fluid*, to the Laws of its *motion*. Neither can any thing else preserve the certain and natural *motions* of any *Body*. Conclude we therefore, that nothing hinders, but that the *Subtil matter* may enter through the *Pores* of the *Glass*, and fill that part of it which the *Quicksilver* hath left.

XVI. *The fifth Argument, taken from united Bodies.*

LUCRETIUS seems to have found out a stronger Argument than all the rest, for the Proof of a *Vacuum*, which is this: If two most exactly *polisht* *Bodies* be apply'd to each other, and touch one another, it will be impossible to remove the one from the other, but that at the same Moment the *whole Surface* of the one would be removed from the *whole Surface* of the other. For tho', it may be, in one part of the said *Surfaces* they might be more distant than in another; yet as soon as they began to open, they would no longer in any part touch each other, save in the opposit extream Line: For otherwise the said *Bodies* could not be smooth and even, but crooked and uneven, which is contrary to this *Hypothesis*. Which being supposed, let the *Air* move with never so great swiftness, yet it can only successively pass the Space which is from the utmost Edge of the *Surface*, to the midst of these *Bodies*; and therefore it is necessary, that at that point of Time wherein the *Air* passeth the Edge or Brim, there must be conceiv'd an *Empty space* reaching to the midst of the Surface of those *Bodies*, which is not filled, but during the Consequent Moments of Time.

XVII. *There are no Bodies in Nature, that are exactly polisht.*

GASSENDUS takes this Argument to be convincing, and that it doth not admit any Answer; but if we well examine what it supposeth, we shall discover it to be *false* and without any ground. For it supposeth 2 *Bodies* exactly polisht, when himself (*Phys. Sect.* 1. *Lib.* 6.) denies, there can be any such: For tho' *Marble*, *Iron*, *Wood*, and other such like *Bodies*, in which we can perceive none of the least unevenness, neither by our Touch or Sight, seem to be most exactly *polisht*; yet Reason will tell us, that they must of necessity be very uneven, because all this polishing is the effect either of *Grains* of *Sand*, or of the Prominencies of *Files*, which cannot but leave Cavities, and consequently an uneven Surface behind them. And therefore it is not at all probable, that there can be found any 2 *Bodies* so even, hard and perfectly polisht, as that no *Air* should be intercepted betwixt them. But if ever 2 *Bodies* exactly polisht happen to be joyned together, then can they not be separated by pulling the one of them upwards perpendicularly, but it will be necessary to draw the upper *Body* away Sideling, and by this means the separation of these *Bodies* is performed, not in a moment, but successively; so that the *Air* doth not easily and readily succeed in the place that is left by them.

CHAP. IV.

Of the Divisibility of Bodies.

I. *Divisibility is a Property that agrees to all Bodies.*

EPICURUS, who asserts that *Material Substance* is compos'd of *Atoms*, and to which he assigns the Rise and End of *Things*; imagin'd that *Bodies* were capable of being divided so long, till at last we come to such smallest *Bodies*, as by reason of their Solidness, do exclude any further division, and by no Natural Force can be any more resolved into Parts, as AUSONIUS hath it:

The Principles of all this Building tight,
Are very small, and such as scape our Sight;
Consisting all of Ranks of Atoms fit,
Which solid are, nor parting do admit.

II. *Gassendus his Opinion concerning the Divisibility of Bodies.*

This Opinion GASSENDUS endeavours to defend, deriving his *Argument* from the Dissolution of *Concrete Bodies*: For as we see, saith he, that Nature resolves *Bodies* into exceeding small *Particles*, and in this dissolution proceeds only to a certain number of them; so we ought to conclude, that Nature doth not still divide *Bodies* smaller and smaller to Infinity, seeing that her Force is bounded, and within a short time becoms exhausted, and ceaseth; and therefore after the utmost of her Activity there must remain *Indivisibles*, and that cannot admit any further Partition.

III. *An Indivisible Body is a Contradiction.*

I know very well, that GASSENDUS doth not attribute a *Mathematical* Indivisibility to *Atoms*, but only supposeth them to be Indivisible, because of their Solidity, and the indiscerpible cohæsion they have of their Parts; but which way soever GASSENDUS may endeavour to explain EPICURUS his Sentiment, Indivisibility seems to be repugnant to the Nature of a *Body*. For *Divisibility* is the Property of every *Material Substance*, and so intimate to it, that it doth immediately and essentially follow the same: For if we carefully heed the Conception we have of a *Body*, we shall find it to be something *Extended*, and *Commensurate* to 3 *Dimensions*: But how can it be that that which is Extended, and consists of *Longitude*, *Latitude* and *Profundity*, should not be *Divisible*? Conclude we therefore, that every

Body

Body is *Divisible*, and capable of an indefinite *Division*, so as that it can never be exhausted by any Partition whatsoever.

IV. *Forasmuch as infinite Points are assignable in a Body, it must follow, that every Body is infinitely Divisible.*

This *Division* is variously demonstrated by *Mathematicians*: We shall give you one Instance, that may serve instead of the rest. Let us suppose *parallel Lines* A B and C D, and the same as to their length *Indefinite*, and a *Fingers* breadth distance from each other: This suppos'd, the *Line* E F, which intervenes between the foresaid *Parallels*, and that perpendicularly, must of necessity be a *Fingers* breadth long. Then taking the *Point* A, of the *Line* A B, which we will suppose also to be a *Fingers* breadth distance from the *Line* E F; let us take above the *Line* C D, to the Right hand of the said *Line* E F, as many *Points* as we please: As for Example, G, H, D, &c. distant from each other at pleasure; and let us conceive, that from the *Point* A, so many *Right lines* do proceed, as to reach to the several *Points* G, H, D, &c. This granted, it is manifest that the *Line* A G, will cut the *Point* I, of the *Line* E F; the *Line* A H, the *Point* L, a little Higher, and the *Line* A D, the *Point* M, which surpasseth the former, or is drawn about it; and so of the rest. But because the *Line* C D, is *Infinite*, and that therefore an Infinite number of *Points* may be taken in it, it follows, that all the *Lines* that shall be drawn from the *point* A, to all the foresaid *points*, will denote Infinite *points* in the *Line* E F, and they different amongst themselves, and which will still more and more approach to the End E, yet so, as that none of all the said *Lines* will ever pass through the *point* E; because it is suppos'd that the *Line* C D, is *parallel* to the *Line* A B. Whence we conclude, that since an Infinite number of *Points* can be assigned in a certain determinate portion of Matter, that *Matter* is infinitely divisible.

Figure 4.

V. *How it comes to pass, that all Bodies are not Equal, seeing that all are infinitely Divisible.*

Some one or other, it may be, will object in favour of GASSENDUS his *Hypothesis*; that if it belongs to the *Nature* of a *Body*, to be *Divisible to Infinity*, it will follow, that any *Body* will be equal to another, which is double its Bigness: But what greater absurdity can there be, than that 2 *Bodies* of different *Magnitudes* should be Equal? and consequently it must be false likewise, that they are both of them Infinitely Divisible. The *Major* is evident, because there is an Infinite Divisibility in the Smaller *Body*, as well as in the Greater, which notwithstanding is twice bigger than it.

VI. *A Finite Mind cannot determine any thing concerning that which is Infinite.*

This *Objection* may be answer'd, *First*, by saying with DES CARTES, *in the First Part of his Principles*, *Article* 26, That we need not trouble our selves too much, to explain or extricate these Difficulties, which are not proportionate to our Intellect, and which cannot perspicuously and distinctly be conceived by us. For it appertains only to *Infinite Mind*, to understand that which is *Infinite*, and to determine any thing concerning it. Wherefore it would be a great piece of Folly, to reject the clear Notion we have of the *Nature* of a *Body*, as false; because we are not endued with an Infinite *Understanding*, and therefore cannot comprehend that which is Infinite. Wherefore also DES CARTES considers all those things wherein we can perceive no Bounds of *Extension*, not as *Infinite*, but as *Indefinite*; because they can be indefinitely divided, and we can never come to the last part of them.

Or, *Secondly*, we may give this *Answer* to the foresaid Difficulty, that the *Divisibility* which is in the lesser *Body*, is not so much as that of the greater *Body*, which is twice as big; that is, the lesser *Body* cannot be divided into Parts, that are as big as those into which the greater is divisible; but yet it may be divided into as many; because *Bodies* are not said to be Divisible with regard to their *Continuous Quantity*, but with respect to their *Discrete Quantity*; for the *Thousandth* part of one *Body* may be divided into other 1000 parts, no less than the whole *Body*: Forasmuch as the Divisibility of a *Body*, or its aptitude to be divided, is not diminished by actual Partition, no more than the Faculty of *Writing* or *Painting* grows less in a *man*, whilst he writes upon *Paper*, or paints upon a *Board* or *Cloth*.

VII. *Two Bodies of different bigness, may be divided into as many parts the one as the other, tho' not into as great parts.*

VIII. *There are innumerable parts in the Body of a Mite.*

It will seem a Paradox to some, that there should be as great a number of Parts in the little *Body* of a *Mite*, as in that of a *Horse*, an *Ox*, or an *Elephant*; yet if we will be pleased to make use of a good *Microscope*, we shall find that the *Body* of a *Mite* is every whit as Organical, as that of the most *bulky Animal*; for we find it hath a *Bill*, with a long *Trunk*, wherewith it pierceth the *Skin*, and draws Blood thence for its *Aliment*. It is seen also sometimes to cast forth *Dung*, of the bigness of a *Flea*; besides which many Asperities may be perceived, as well on the outside, as on the inside of its *Skin*, and 2 branching *Horns* on its *Forehead*, and 6 *Feet* on each side, like to those we see in *Crabs*, long-wise extended from the sides of it, 2 whereof support the fore-part of this little *Animal*, and the other 4 the hind-part. But tho' all these outward parts of this little *Animal* be considerable for their number, yet are they but very few, if compared with many parts which lye hid in the inside of it. For it must have a *Stomach*, *Guts*, a *Heart*, a *Brain*, wherewith to perform the Functions of *Life*. It must also have *Veins*, by which its *Aliment* may be conveyed throughout all the parts of its *Body*; *Arteries*, to conveigh the *Vital Spirits*; and *Nerves*, to convey the *Animal*; besides, *Muscles*, *Tendons*, *Joints*, and innumerable other parts conducive to its *Nourishment*; *Sensibility* and *Capacity* of moving it self, and exerting all the other Functions of *Life*. All which Parts, tho' they be very small, yet are they no less divisible than those which are much greater, because they are extended, and separable into Parts.

IX. *GOD can produce Animals infinitely lesser and lesser, than others.*

Wherefore seeing that the Demonstrations concerning the Divisibility of the Matter are clear and evident, we may assert, that there may be *Bodies*, yea, and *Animals* too, still less and less than others, and that into Infinity, tho' our *Imagination* can frame no Conception of them: For why might not we say with sufficient certainty, that all *Animals* are in little in their *Seed*? Seeing that we see in that which we call the *Treadle* of an *Egg*, (which was never *set* upon) a *Chicken*, which for ought we know, is entirely formed; and that we see whole *Frogs* in the *Spawn* of *Frogs*. It is also very probable, that in the *Bud* of a *Mustard-seed*, and of the *Kernel* of an *Apple*, by Example, there are infinite *Trees*; because it not only contains the *Tree*, whose *Seed* it is, but also a vast number of other *Seeds*, which it may be, contain within them also other *Trees*, and other *Seeds*; which other *Seeds* do probably contain still other and more

Trees,

Trees; and other *Seeds*, as fruitful as the first were, and this to Infinity.

X. *The Bodies of all men were produced from the Beginning of the World.*

Neither may we only conclude, that *Plants* are contained in the *Buds* of their *Seeds*, but that all the *Bodies* of *Men*, and of *Animals*, that shall be born for the future, even to the end of the *World*, probably were produced from the first Beginning of the *World*: I mean, that the *Females* of the first *Animals*, have probably been created, with all those of the same *Species*, which they have already brought forth, or shall do to the end of the *World*.

CHAP. V.

Of Loose and Close Bodies.

I. *A Sponge becomes distended and swell'd by Liquor.*

A *Sponge*, by letting in of *Water*, or any other *Liquor*, swells and is pufft, and spreads it self into a larger Bulk.

Some suppose that a *Sponge* is rarefied by the increase of some new *Quantity*; as if nothing of Foreign Matter did enter into it, but only that some supervening *Quantity* doth separate the parts of the *Sponge*, and increaseth its bigness. But who can believe that when *Water* is rarefied, and in a manner turned into *Air*, it is only thus dilated by the increase of *new Quantity*? Who perceives not that the *Sponge* sucks in Moisture, and hides the same within it self, which afterwards upon the squeezing thereof, runs out again, whereupon the Parts come closer together. A *Sponge* therefore becomes rarefied or dilated, when the parts of it are somewhat removed from each other, and that the *Pores* of it are fill'd with supervening *Water*. And the same *Sponge* again grows close, when its Parts are brought nearer together, by the Expulsion of that Matter, which before kept them at a greater distance. So that a *Sponge* may not only be said to be a *Loose Body*, whilst it is dry and free from all Moisture; but also, and more especially, when it hath all its *Pores* fill'd and stufft with *Foreign Bodies*.

II. *Why some Bodies are more apt to be rarefied than others.*

Glass becomes dilated to a greater Space by *Heat*, than *Metals*; and of *Metals*, *Iron* is more dilatable than *Copper*; *Copper*, more than *Silver*; *Silver*, more than *Gold*; and *Pewter* more than *Lead*.

The Reason of all which must be fetch'd from the greater Porosity of those *Bodies* that are more light than others; for the more *Pores* there are in any *Body* that is capable of being *Rarefied*, the more *Bodies* may insinuate themselves into it, and by this means it becomes rarefied or distended.

III. *The motion of Rarefaction is more intense at the beginning.*

The *Curious* Searchers of *Nature* observe, that the Motion of *Rarefaction* is more *intense* at the beginning, and more slow and remiss towards the end thereof. They produce several *Experiments* to prove this; and more particularly from that of *Weather-Glasses*, exposed to the Heat of the *Sun*, uniformly, and continually applied to them; or set in *Water* that is kept in the same degree of *Heat*.

The Reason whereof is, because *Rarefaction* being caused by the admission of some thin *Substance* into the *Pores*, the more the said *Pores* are dilated by the violent ingress of *new Matter*, the more the Parts of the *Body* rarefied become distended, and therefore do still more and more resist and oppose any further distension.

IV. *What is the Reason that Gates and Dores do easily shut in dry weather, and more hardly in Moist and Rainy.*

Gates and *Doors* frequently cannot be shut or opened, in Moist weather, without some difficulty: Whereas the contrary happens in the *Boards* whereof *Barrels* are made, which when expos'd to the *Air* in Dry weather, do open and make the *Vessels* to become leaky.

The *Reason* is, because *Gates* or *Doors* do swell in Wet weather, for that the *Water*, or the *Air* fill'd with *watry Vapours*, penetrates the *Pores* of the *Wood*, and distends the Sides of them, which being dilated, the whole Bulk of the *Body* must needs be distended likewise, and take up a greater Space than it did before. In like manner *Linnen-Cloth* is rarefied by the Accession of *Water*, *Water* by that of *Air*, *Air* by that of *Æther*, and *Æther* by that of a more *subtil Body*, if any such there be, and by this means take up more Room than they did before.

V. *Why the Strings of an Instrument do swell by the Moistness of the Air.*

Thus also the *Strings* of a *Violin*, or other *Instrument*, do swell in *Moist weather*, as appears by their breaking, and by the difficult winding of the *Pegs*. In like manner *wooden Bowls* are apt to get *Slits*, if they be put into *Water*, and the *Water* penetrate them. Some very credible *Authors* relate, that *Earth* taken up from those parts that are near to the River *Nile*, do increase every day in weight, from the time when that *River* begins to swell, until it be arrived to its greatest height. Which cannot proceed from any thing else besides the *Air*; which being condensed at that time, and clogg'd with *watry Particles*, doth increase the weight of the *Earth*.

VI. *How an Obelisk, moved out of its station, was put to rights again.*

By the same means an *Obelisk* at *Constantinople*, which was got out of its place, was put to rights again; for the *Artificer*, who had undertaken the Work, having caused very strong and thick *Ropes* to be tied to the *Obelisk*, and fastned to some strong *Hold-fast*, caused the said *Ropes* to be moistned, by pouring great quantities of *Water* upon them, which causing them to swell, and consequently shortning their length, lifted up the *Obelisk* to its former situation upon its *basis*. For *Ropes*, consisting of long and twisted *Threads*, by admitting the *Moisture* into their *Pores* or *Intervals*, the more they swell in thickness, the more contracted their length is.

VII. *How Mill-stones are separated from the Rocks, whereof they were a part.*

It is after this manner that *Mill-Stones* are separated from the *Rocks*. For they make abundance of Holes about the said *Rocks*, into which they drive *wedges* of *Wood* that have been dried in an *Oven*; which *Wedges* being placed around in the form of a *Cylinder*, according to the bigness that we would have the *Mill-Stones* to be of, when *Moist weather* comes these Wedges swell, and by their swelling separate the *Mill-Stones* from the rest of the *Rocks*; so that it is evident, that this Separation is made by the *Vapours*, which would be very difficult to perform any other way.

VIII. *Why the Staves of Barrels are contracted in hot and dry weather.*

The *Staves* of *Barrels* take up less room in *Dry weather*; for seeing that their Parts are agitated by *Heat*, some of them fly away into the *Air*; which being gone, it is no wonder if the *rest* come closer together, and do not take up so much place as they did before.

IX. *A Bar of Iron put into the Fire, swells and becomes dilated.*

Take a *Bar* of *Iron*, for Example, of 2 Foot long, and a *Stick* or piece of *Wood* of the same bigness; then put the *Iron Bar* into a strong *Fire*, till it be *red hot*, and then compare it with the piece of *Wood* which was of the same dimensions with it, when it was first put into the *Fire*, and you'l find the *Iron* to have been increased, not only in Breadth, but in Length also, and in both

to exceed the *Piece of Wood* which was equal to it before; but as soon as it is grown cold, we shall find it restor'd to the same dimensions it had before it went into the *Fire*.

The Cause whereof is the *subtil Body*, which enters the *Pores* of the *Iron*, *viz.* the *particles* of *Fire*, which dilate it to a greater Extension. For the *parts* of *Fire* being in continual *motion*, must needs distend the Sides of the *Iron Bar*; which when expos'd to the *Air*, and being cooled, returns to its former Extension, because the *particles* of *Fire* leaving its *Pores*, and those of the *Air* entring into them, and not being moved with the swiftness and violence that those of the *Fire* are, they do less distend them, and consequently the *Bar* of *Iron* must take up less room than it did before.

X. *Why a hot-Iron cuts Glass.* Hence also it is, that with a *Red-hot Iron*, or with a piece of *Packthred* dipt in *Brimstone* and set on *fire*, *Glasses* are cut; because the *particles* of the *Glass* being agitated by the *heat* of the *Fire*, require a greater Space, and consequently drive their contiguous Parts further from them. And it is for the same Reason, that *Metals* in fusion swell, and take up more room than they did before.

XI. *Water rarefied into Vapour, takes up an hundred fold larger Space, than it did before.* *Water*, by the *virtue* of the *Sun*, is lifted up into the *Air*, and becomes thereby so diffused, as to take up a greater Space than it did before; for if we may believe the account that some give us, *Water* turned into *Vapour*, fills a Space 100 times larger than that was which it took up before.

The Cause of which Diffusion is not to be attributed to the *parts* of *Water*, as some falsly do imagine; since it is impossible that the *Dimensions* of a thing should be increased, except that some other *Body* be added to it. And consequently the *Water* becomes dilated, when its Parts remove farther from each other, and so give way for the entring of some Foreign *Body* between them. After the same manner as when a *Heap of Dust*, by the *Wind* is lifed up, and disperse'd in the *Air*: For this Expansion is not to be attributed to the *particles* of *Dust*; but to the *Air*, which fills the *Intervals* between them, and separates the *particles* of *Dust* from each other.

XII. *Why Bodies that are condensed, become of a white Colour.* *Condensed Bodies*, and such as after *Rarefaction* are reduced to a less Room, are commonly of a white Colour; as *Butter*, *Grease*, *Oil*, and such like.

The Reason whereof is, because in *Condensation* those *particles* are expell'd, which swell'd the *Grease* or *Oil* into a greater Room, whereupon their parts must needs come closer together, and be contracted, as it were, into small round *Pellets*, which afterwards, like so many round *Looking-Glasses*, do reflect all the Light, and produce a *white Colour* in the condensed *Subjects*. For there are two things especially, by means whereof *Bodies* acquire a *white Colour*: The *First* is, That they consist of little and innumerable *Surfaces*, disposed to receive and reflect the *Light* in such a manner, as that it may suffer no loss, either by *Refraction*, or by the mixture of *Shadow*. The *Second* is, That the whole *Light* which shines upon a *Body* be *reflected*, without having any Beams swallowed up in the *Pores* of it. To the effecting whereof little round *Bodies* do conduce most; as will appear, when we come to speak of *Heat*.

New Beer or *Wine*, if it be put into *Bottles*, doth swell and work with that Violence, that it frequently breaks them.

XIII. *What is the Cause of Fermentation in New Beer or Ale.* Which *Fermentation* is caused by the *Heterogeneity*, or the Diversity of the parts of *Liquor*; which cannot unite together, by reason of the variety of their *figures*, and therefore endeavour to extricate themselves from the Society of each other. And that this is the true Cause of the *Fermentation* of *Liquors*, appears from hence, that after these *Liquors* are separated from their *Heterogeneous* parts, they are no longer agitated with any such tumultuary Motions; as is evident in *Burning Spirits*, *Distill'd Water*, and the like; which may be kept a long time without suffering any Change. For the *Spirit* of *Wine* being kept closely stopt, is not capable of any agitation of its parts; but if a little *Turpentine* be mixed with this *Spirit*, the parts presently begin to tumultuate, and endanger the breaking of *Vessels* Hermetically sealed.

XIV. *Bread made of sprouting Corn ferments of it self.* If *Bread* be made out of the *Flower* of grown or sprouted *Wheat*, it will ferment and rise without the addition of any *Leaven* of *Yest*.

The Cause whereof is, because the stiff and sharp *particles* of *sprouted Wheat* do infold themselves; and, as the *Chymists* express it, are in their greatest Exaltation: Wherefore, as soon as the *Dough* begins to grow hot in the *Oven*, the parts thereof become tumultuarily agitated, and driving the resisting *Bodies* before them, do in a manner præcipitate them, and by this means the *Bread* becomes spongy and light.

XV. *How the Air comes to be condensed or rarefied in a Weather-Glass.* Let a *Weather-Glass* be fill'd with *Aqua-fortis*; but so as that when fill'd, there may be some Space left, taken up by the remaining part of the *Air*, which was before in the *Glass*, *Tube* or *Pipe*: You'l find that this part of *Air*, being dilated by a more intense *Heat*, upon the recess of the *Aqua-fortis*, retiring it self into the lower Head of the *Tube*, will fill the whole Capacity of the *Tube*; and that on the contrary, by *Cold* it will be contracted into so narrow a room, as that the whole *Tube* almost will seem to be filled with the *Aqua-fortis*.

Which Variety proceeds from the continual ingress of *new Matter* through the *pores* of the *Glass*, which doth so rarefie the impure *Air* contained in the *Glass*, that by the separation of its *particles* from each other, it drives the *Aqua-fortis*, being unable to resist its place; whereas upon the egress of the *subtil Matter* through the *Pores* of the *Glass*, the *particles* of the *Air* coming then closer together again, the *Aqua-fortis* returns to its former place, being drawn into it by the *Air* that enters at the lower end of the *Glass*. And if the *weather* be very *Cold*, that part of the *Air* which is in the upper part of the *Glass*, upon the recess of the *subtil Matter*, doth so greatly decrease, as that the whole *Glass* becomes fill'd with the *Aqua-fortis*.

XVI. *Why a Chest-Nut cast into the Fire breaks with a great noise.* A *Chest-Nut* put into the *Fire*, first *swells*, and soon after *bursts*, giving a great Report. Which doth not proceed from any foreign Matter that enters the *Chest-Nut*, but from the grosser parts of it, which the action of the *subtil Matter* entring into the *Pores* thereof, separates from each other, and doth so agitate, that at last they burst the *Shell* with a great noise.

In

XVII. *How a Marble Pillar was broken to shivers.*

In like manner, a vast *Marble Pillar* mentioned by CABÆUS, was broken all to shivers, by kindling a *Wood Fire* round about it: For the heat of the *Fire* rarefying the *Air* contained in the *Pores* of the *Marble*, makes, that it cannot be lodged in the narrow Room it took up before, and therefore in striving to get forth into a large Space, it breaks and rends the *Marble* to pieces.

XVIII. *The vast dilatation of a grain of Gun-powder.*

This *Dilatation* of *Bodies*, is the Cause sometimes that a very small *Body* becomes diffused into an incredible distension; as we see in *Smoak*, *Vapours* and *Flame*, which *Dilatation* is so great, that one Grain of *Gun-powder*, according to the Demonstration of *Joh. Chrysost. Magnenus*, when kindled, becomes dilated into a *flaming Sphere* 3804 times greater than it was.

CHAP. VI.

Of Hard and Fluid Bodies.

I. *Whence the Hardness of Stones and Gems does proceed.*

Bodies are distinguished by *Hardness*, as *Stone*, *Wood*, *Whet-stone*, *Pumice-stone*, *Gems* or *Precious Stones*; some whereof are broken with ease, and others not without great difficulty.

We account those Bodies *Hard*, the parts whereof are at Rest together, and are so closely united, as that they are not interrupted by any other *Matter* moving between them. And accordingly those things are accounted the most hard and *firm* whose parts are inflexible, and touch one another. And therefore *Precious Stones*, tho' they all agree in this, that the *File* will not touch them; yet some of them are harder than others. For some of them are polisht with *white Lead*, others with *Copper*, others with *Emery*. Thus we find a great difference there is betwixt a *Diamond* and *Crystal*, tho' both of them proceed from the same Matter, and grow in the same places; because *Crystal* is much more soft, its *Parts* being not yet firmly grown together, but agitated with various Motions. Whereas the *Diamond* is much more firm and compact, by reason that its insensible parts do more immediately touch each other, and are more intimately and close entangled by mutual cohæsion.

II. *A Hard Body suspended in the water moves more swiftly in a Right Line, than the VVater it self doth.*

When a *Hard Body* is suspended in the *Water*, if the *Water* move in a right *Line*, the said *Hard Body* will move more swiftly than the *Water* following the same *Line*.

The Reason whereof is this, because all the *parts* of a *hard Body* have but one and the same determination, and the several parts of the *Water*, or other *Liquor*, have every one of them theirs, which greatly retards their motion in a *Right line*.

III. *A Hard Body, that swims upon the water, moves more slowly than it.*

And on the contrary, a *hard Body*, that *swims* upon the *water* of a *River*, moves less swiftly than the *River*: For tho' all the parts of the *Hard Body* have but one only determination, and those of the *Water* have many; yet is this over and above recompensed, by the less degree of Solidity in the said *Body*, which is the Cause that it keeps above the *water*, and so has fewer parts of *water* to push it forwards, and more of *Air* or *subtil Matter* to resist its motion.

IV. *Why burnt Bricks are more hard than those that are not.*

Bricks, made of *Clay*, become harder by being burnt or bak'd in the *Fire*; notwithstanding that after their *Burning* they have larger *Pores*, and that their *parts* are further distant from each other.

I suppose, that this hardness of the *Bricks* is caused by the action of the *Fire*, which not only drives out of their Cavities the *parts* of *water*, which I conceive to be long and slippery, like little *Eels*; but also all their other *fluid Parts*, which are not very close joyned together. Whence it comes to pass that these being taken away, the remaining parts come closer together, wherein the Nature of *Hardness* does evidently consist.

V. *Why some soft Bodies grow hard.*

From this new entanglement of the *Parts* it comes to pass, that many *Plants* in *Brazile*, which whilst they stand in the Ground are very soft and flexible, being pluckt up, within a short time after become inflexible and very hard. I remember to have read somewhere of a certain kind of *Clay*, which as long as it lies at the bottom of *Rivers*, and is cover'd with *water*, is very pliant; but being taken up into the *Air* grows hard immediately, and becomes very firm and stiff.

VI. *How Wood comes to be turn'd to Stone.*

Yea, what is more, we find sometimes that *Pieces of Wood* are turn'd to *Stone*, and that by means of a *petrifying Juice*, which being got into the *pores* of the *Wood*; and the *watry parts* of the said Juice being exhaled, leaving the *Earthy* and *Stony parts* in the *Pores* of the *Wood*, impart to it the Weight, Hardness, and other Affections of *Stones*. For *Wood* thus changed into *Stone*, becomes thereby almost 6 times more ponderous than it was before; and the remaining parts of *VVood* are so closely entangled and joyned with the superadded Sandy *particles*, that they can no longer be consumed by the *Fire*.

VII. *The way of preparing the Wood, whereof Musical Instruments are made.*

It is an unquestionable Truth, that *Bodies* which are agitated with a slow and intestine *motion*, do in process of time grow more hard and solid. For the *Wood* whereof *Musical Instruments* are made, require much time before they can be brought to the highest disposition and fitness for that use, even from the time of 20 to 80 years sometimes. They who make *Vessels*, and other *Utensils* out of *Guajacum*, tell us, that they must let it lye 20 years before it be fully fit for some of their uses. So much time is required, that all the *Volatile* and *watry Particles* being exhaled, the solid Parts may come more closely together, and attain that fit firmness and dryness which is necessary for them.

VIII. *How Water, Broath, Blood, &c. become hard.*

VVater becomes congealed into *Ice*; *Broath*, *Blood*, and the like into *Jelly*, and attain all of them to some degree of Firmness. Which happens, because their *Particles*, upon the ceasing of the outward agitation hang together, and more closely embrace one another. For *Blood* and *Broath* become more firm by the Exhalation of their thinner Parts, the thicker staying behind, which being closely entangled together, are fixed by the rest. The same we experience likewise in *Oil* of *Annis-seeds*, which in the *heat* of *Summer* continues fluid, and stands in need of a *Vessel* to contain it; but at the approach of *VVinter*, when the Solar Beams do more weakly beat upon the *Earth*, it becomes a *hard Body*. So likewise *Milk*, which of its own Nature is *fluid*, and doth easily insinuate it self into other *Bodies*, yet becomes coagulated into

into *Cheese*, when the *slender*, *stiff* and *sharp Particles* that are in the *Rennet*, have penetrated the substance of the *Milk*, which by agitating the *particles* thereof, drive the branchy flexible parts together, and by their weight expel the smaller *particles* of *Whey* out of their places. *Milk* also is turned into *Butter*, when the parts of *Cream* being agitated by perpetual *Churning*, are separated from the rest, and by their *Branchy particles* entangling together, do unite into one continuous *Body*.

IX. *Why Water riseth higher in the lesser Branch of a crooked Glass-Pipe, than in the greater.*

The *water* which is in a *Crooked Pipe* of *Glass*, riseth higher in the less branch of it, than in the greater. Because there are more *Lines* of *Air*, that act upon the Liquor that is in the great Branch, than upon that which is in the lesser: Whence it follows, that if the *Liquor* stop in the great Branch at A B, it will not stay in the lesser at G E, which is level with A B, but will mount upwards towards D, where I suppose that the weight Figure 5. of the *water*, which is above the *Level* G E, doth compensate or make good the *inequality* of the pressions of the Lines of *Air*, which act upon both the Branches. Wherefore seeing that this *Inequality* is by so much the greater, by how much the Mouth of the little Branch is less, or narrower, because the lesser the Hole is, the less power the *Air* hath to exert its activity upon it; therefore the less the Hole is, the higher will the *water* mount above the Level. This is no more than Experience confirms to us: For when the *Pipe* is about the thickness of a *Quill*, the *water* mounts only the height of 2 or 3 *Lines*; whereas if it be so small that scarcely a *Horse-hair* can enter it, the *water* will mount the height of 10 or 12 *Inches* above the Level.

X. *Salt is dissolved in Water, by the motion of it.*

Salt melts in *Water*, notwithstanding that it is more ponderous than *Water*, and sinks to the bottom.

Which happens, because the parts of *VVater* being in continual motion, do insinuate themselves into the *particles* of *Salt*, and having dissolved their connexion, do separate them from one another and spoil their Continuity. For this melting or dissolution of *Salt*, cannot be brought about without *motion*: For tho' the *Water*, which is contain'd within the Hollow of a *Glass-Vessel*, seems not to move; yet considering the fluidity of *VVater*, we must conclude, that some of its insensible Parts are continually moving upwards and downwards, as well as from side to side of the *Vessel*: By which agitation the parts of the *Salt* become dissolved, and are separated from each other.

XI. *How Metals are dissolved in the Stygian Waters.*

Thus also *Metals* are dissolved in *Acid Spirits*, and that within a short time. And for the same Reason it is, that when *Oil of Tartar per deliquium* is instill'd into these *Stygian waters*, it produceth a great ebullition or effervescence. And it is for no other Cause, that *Bread* or any other *spongious Body*, if it be but slightly dipt in *water*, is spoiled thereby, than this, that the *Particles of the water* being in continual agitation, do enter the *Pores* of those *Bodies*, and by this means make a separation of their parts from each other.

XII. *How fluid Bodies come to be hard.*

Liquid Bodies do frequently become hard and firm: Thus the *white* of an *Egg*, by boyling, becomes hard.

This Hardness proceeds from the Contexture and *Figure* of their *parts*, whereby they are so adapted together, as to cling to one another as it were with *Hooks* and *Holdfasts*, so as that afterwards they can no more continue their motion. Thus the most highly *Rectified Spirit of Wine*, and the *Rectified Spirit of Urine*, being poured together, joyn and coagulate in the form of *Snow*. Because the dissolved *Sulphur*, which constitutes the *Spirit of VVine*, having insinuated its little Branches into the *Pores* of the *sharp Volatile Salt* of the *Spirit of Urine*, doth so link the parts together, and reduceth the *Pores* of that Compound to such a narrow compass, that the Matter of the First and Second *Element*, which passeth through them, is not capable of imparting to those *Liquors* their ordinary Fluidity; and by this means are reduced to the consistence of a kind of *Hard Body*. The same effect is also produced by mixing *Spirit of VVine* with the beaten *VVhite* of an *Egg*. And it is for the same Reason that *Spirit of Turpentine*, after reiterated *Distillations*, is turned into a *hard Body*.

XIII. *How common Water, impregnated with* Saltpeter, *grows hard.*

Common-water, that hath run through *Earth* that is impregnated with *Nitre* or *Saltpeter*, and set upon the *Fire* to *boyl*, continues as Liquid as ever; but being removed from the *Fire* and grown cold, it sets a Mass of *Salt*, and becomes Crystalliz'd.

The Reason whereof is, because the *VVater* being grown *cold*, many of those *particles* of *Salt*, which were agitated by the *heat* of the *Fire*, cease their *Motion*, and coming closer together, embrace one another; and by this means are *Crystallized*, and return to their former *figure*: *Alom* yielding 8 Corner'd *Crystals*; *Salt Armoniack* 6 Corner'd; *Sea Salt*, Cubical or Square; *Salt Nitre Pyrimidal*; and other *Salts*, *Crystals* of other *Figures*.

XIV. *How a Sillibub is made.*

When any *Sowr Liquor* is poured into *warm Milk*, immediately the *Curds* are by this means separated from the *VVhey*; as appears in that *Drink* so familiar amongst us here in *England*, called *Sillibub*.

This Separation happens, because *Milk* is not altogether *fluid*, but is of a somewhat thickish consistence, whose *Pores* are encompass'd with grosser parts, which are the *Curds* whereof *Cheese* is made: And therefore when any sharp or subtil *Liquor* enters the same, such as *Vinegar*, *Cider*, or the like, it drives away the grosser *Particles*, that fill the *Pores*, which thereupon joyning together, become separated from the *VVheyish* part. The same also happens when *Milk* is kept so long that it turns *sowr*; for then, without the assistance of any *Rennet* or foreign *Liquor*, it is precipitated and falls down to the bottom, especially if it be set near the *Fire*; because when *Milk* grows stale, its thinner parts become *fluid*, and being sowred with the *warmth*, serve instead of *sowr Liquor* or *Rennet*, to run the *Milk* together.

XV. *Oil cannot be taken out of a Cloth by Water, but well with Soap.*

Oil cannot be washed out of *Cloth* with *water*, but *Lie* must be us'd, or *Soap*, which is not so fluid as *water*, but by its consistence appears to be endued with a far less degree of *Motion*.

The Cause whereof is, because the *Parts* of *VVater*, as to their *Figure*, differ from those of *Oil*, and therefore cannot penetrate or divide each others Parts: For the *particles* of *Oil* are *Branchy*, whereas those of *VVater* are *slippery*, and much in the shape of *Eels*: For which Reason also they enter

enter the *pores* of a *Cloth* ſtained with *Oil*, and leave the *particles* of *Oil* untouch'd. For *Water* hath not the force to enter into *Oil*, or to penetrate into the inmoſt parts of it, and conſequently cannot carry off any parts of the *Oil* with it. Whereas *Lie*, becauſe of the *Salt* that is mixed with it, doth readily perform it; for the parts of *Salt* being ſtiff and inflexible, and therefore like ſo many *Darts* piercing into the parts of *Bodies*, doth eaſily looſen the *particles* of *Oil*, and being mixt with *water*, eaſily carries off the *Oil* with it. And hence it is that *Soap* is of ſo great uſe, for the taking of *Spots* or *Stains* out of *Cloaths*, becauſe it conſiſts of *Salt*, *Oil* and *VVater*. For the little *particles* of *Oil*, becauſe of their familiarity, are eaſily united, which the *water* extracts by being joyned with the *particles* of *Salt*.

XVI. *What is the Cauſe of the Riſing or Falling of water in a Glaſs.*

When any *Liquor* is put into a clean *Glaſs Veſſel*, having an even Brim, and fill'd up to the top, the Surface of it appears *plain* and *even*; but not ſo when the *Veſſel* is only fill'd in part, becauſe then the *ſurface* of the *Liquor* ſeems to be concave or hollow in the midſt.

The Cauſe hereof is, becauſe the *Air* in the former caſe doth with an Equal force preſs upon the *Liquor*; nor can any Reaſon be aſſign'd, why it ſhould preſs one part of it more than another. Whereas in the latter caſe, the *Air* being whirl'd round about the *Glaſs* with *water*, whilſt from abroad it enters into the hollow of the *Glaſs*, it is not ſo much diſpos'd to turn its Force towards the Sides of the *Glaſs*, as to continue its motion towards the midſt of the *water*; and conſequently preſſeth the *Liquor* more in the midſt, than towards the Sides of it, which therefore are ſomewhat higher than the midſt, which by the greater preſſure of the *water* links ſomewhat lower.

XVII. *VVhence water comes to have a round Figure.*

But if you pour into a *Pipe*, or other *Veſſel*, ſomewhat more *water* than it is well able to hold; becauſe that part which is ready to ſpill over the brims of the *Veſſel*, is more expos'd to the *Air*, than that which is elſewhere; therefore the *Air* drives it by its preſſure more towards the midſt, where is the hiteſt place for it to ſwell or riſe higher. Thus we ſee that the *water* in this *Pipe* or *Veſſel* ſwells above its brim, and that the ſwelling or *Rounding* thereof comes nearer to a perfect *Round* in a ſmall or narrow *Pipe*; becauſe where the *Veſſel* is very large, the Force of the *Air* is not ſtrong enough, to overcome the weight of ſuch a great quantity of *water*.

XVIII. *VVhy a Leaden Bullet is more eaſily beat flat upon a Cuſhion, than on an Anvil.*

A *Leaden Bullet* being laid upon a Cuſhion, or a pendulous *Anvil*, is more eaſily beaten flat, than upon an *Anvil* that ſtands faſt and immoveable.

The *Reaſon* is, becauſe it is not ſufficient to the beating of a *Bullet* flat, to ſtrike it with a great force; but it is over and above requiſite that this Force continue for ſome time, that the parts of the *Bullet* may have leiſure to alter their *ſituation*: But when ſuch a *Bullet* is laid upon an immoveable *Anvil*, the *Hammer* leaps back almoſt the very ſame moment it ſtrikes the *Bullet*, and ſo hath not time enough to flat it, as it hath when it can continue longer upon it, as when it is laid upon an *Anvil* or other Body that gives way to the ſtroak of the *Hammer*, and doth not by its Solidity immediately beat it back. Thus the *Shinbones* of a *Sheep* are more eaſily broke upon the hand, than upon an *Anvil*; becauſe the Hand, by giving way to the force of the ſtroke, aſſiſts the breaking of it.

XIX. *How a Leathern Ball or Bladder is made hard, by the Air that is blown into it.*

When *Air* is blown into a *Leathern Ball* or *Bladder*, it makes it to become hard, tho' the *Air* of it ſelf hath nothing of Hardneſs in it.

The *Reaſon* is, becauſe the parts of *Air* that are pent up in a *Leather Ball*, or *Bladder*, being unable to penetrate the Parts thereof, are by this means ſo much compreſt, that thereby they are forced to change their *figures*, and bend like ſo many little *Bows*, which endeavour to return to their former and natural poſture; and by this means ſo diſtend the *Ball*, and make it feel hard to the Touch.

XX. *Liquid Bodies are ponderous, proportionably to their height.*

Fluid Bodies, that communicate with other *fluid Bodies*, are Heavy, proportionable to their *Height*, and not according to their *Breadth*. As for Inſtance, Let us ſuppoſe a *Veſſel* full of *water* A B C D; having 2 Openings or Mouths of unequal bigneſs E and F, to which are ſoder'd 2 *Pipes* likewiſe unequal, ſuch as G and H. This ſuppoſed, if you pour the ſame *Liquor* into the ſaid 2 *Pipes* to the ſame height, both the *Liquors* will be in an Equal poiſe. Figure 6.

The *Reaſon* is, becauſe their Height being the ſame, they are in proportion to their *Thickneſs*; that is to ſay, if the Hole E be double to that of F, there is alſo twice as much Liquor in the *Pipe* G E, as there is in that of H F; whence it follows, that the *Liquor* of the great *Pipe* cannot ſink 1 *Thumbs breadth* lower, but it muſt make that in the leſſer *Pipe* to riſe 2; nor can that of the leſſer ſink lower by 2 *Thumbs breadth*, but it muſt make that in the greater *Pipe* to riſe 4 *Thumbs breadth*, which makes an equal quantity of *motion* on either ſide, and conſequently the *water* continues in equal poiſe in both the *Pipes*.

XXI. *VVhy a Beam of wood lies unmoved in the water, tho' the parts of the water are in continual motion.*

A *Hard Body*, for Example a Beam of *Wood*, being in the midſt of a *Pond*, continues unmoved; and except by outward force it be put into *motion*, it always obſerves the ſame diſtance from the *Bodies* that ſurround it.

Which proceeds from hence, for that the Parts of the *Fluid Body*, which every way encompaſs the *Wood*, are toſt with various *motions*, ſome upwards others downwards, ſome to the Right, and other to the Left; ſo that the *Wood* receiving all their contrary *motions*, reſts in an equal poiſe between them all; ſince there is no cauſe that might incline it one way more than another. But if the whole *Fluid Body* tend one way, the *Wood* will be forc'd to comply with its *motion*, and be carried along with it; becauſe in this caſe the Contrariety of the *motions* in the *water* is removed, by the *waters* running one way only.

XXII. *VVater ſometimes conduceth to the Hardneſs of Bodies.*

The *Plaiſter* wherewith the *Walls* of *Houſes* and *Roofs* are cover'd, grows hard by its being mixed with *water*, and by this means acquires a *firmneſs*, which it never had before.

Some do imagine the Cauſe hereof to be from the ſudden evaporation of the parts of *Water*, which by being ſublim'd into the *Air*, leave the reſt of the *Body hard*: But Experience teacheth us the contrary; for if *Plaiſter of Paris* be weighed whilſt it is almoſt Liquid, and be afterwards weighed again, after that it is grown hard, it will be found to have loſt nothing of its weight.

For my part, I ſuppoſe this Hardneſs is produc'd, becauſe in the *Plaiſter* there are many *Pores*, which the *Fire* hath formed in it, and are ſuch as that the thicker *Particles* of *Air* cannot enter into them, becauſe they have not ſtrength enough to remove thoſe Obſtacles which they meet with in the *Plaiſter*; which yet the *particles* of *Water* can do. Whence it comes to paſs, that the *water* having been variouſly agitated with the *Plaiſter*, by flowing about the Grains or Clots of it, variouſly opens the *Pores* of it, and divides it into much leſſer parts than it was before: And foraſmuch as theſe *Particles*, by being reduced into moſt fine powder, have acquir'd more Surface than they had before, when they were yet in *Clots*, being now joyned together by a more immediate contact, they do conſtitute a *hard Body*.

XXIII. *Why Cement becomes as hard as Marble.*

And it is for the ſame Reaſon, that a *Cement* made of *Flower, the White of an Egg* and *calcin'd Stones*, turns as hard as *Marble*, wherewith the Sides of that wonderful *Fiſh-Pond* at *Cuma* is walled. So likewiſe it is a thing well known, that the *Powder* of *Flints* and *Loadſtone* being mixed with the *white of an Egg* and *Sanguis Draconis*, doth within a few days become an exceeding hard Maſs.

XXIV. *Why Aqueous Liquors are eaſily reſolved into Vapours; but fat and Oily Liquors not ſo.*

Aqueous and *volatile Spirituous Liquors* are eaſily reſolved into *Vapours*; whereas *fat* and *oily* are not without much difficulty exhaled.

The Reaſon is, becauſe the parts of the former, are endued with very ſimple *Figures*; whereas thoſe of *fat Liquors* are of more intricate *Figures*, like Branches of *Trees*, by which means they hang and cling cloſe together, and therefore cannot without difficulty be ſeparated from each other.

CHAP. VII.

Of Rough and Smooth Bodies.

I. *Many Bodies that appear ſmooth and poliſht to ſight, are rough notwithſtanding.*

Marble, Steel, Wood, &c. appear *ſmooth*; but yet are found to be *rough* by the help of a *Microſcope*.

The *Reaſon* is, becauſe *Bodies* are commonly poliſh'd with the help of very hard *Powders*, the *grains* whereof cannot but leave Cavities, and conſequently Unevenneſs in the Surfaces of the *Bodies* ſo poliſhed. *Pumice-ſtone* is alſo made uſe of to this purpoſe; becauſe by its Roughneſs, it rubs and wears off the Prominences of the parts. And with theſe *hard Powders* always ſome *Water* or *Oil* is mixt, which prepares the *matter*, and conveys the *powder* into all the Cavities of the *Stone*, or other Subject that is to be poliſhed. But however, after all the pains that is taken, Art can never ſo poliſh *Bodies*, but that ſome inſenſible Prominences and Subſidences will ſtill remain.

II. *Glaſs and Cryſtal are not abſolutely ſmooth Bodies.*

Thus *Glaſs*, *Cryſtal*, and the like, tho' they ſeem to be the ſmootheſt of all other *Bodies*: Yet may truly be ſaid to be *Rough*; for tho' *Glaſs* be made by *fuſion* of the ſmalleſt *particles* of *Aſhes*, yet foraſmuch as they are irregular and angulous, they cannot be ſo bent by the force of *Fire*, as to cling cloſely together, and by this cohæſion to loſe all their own *Figures*: For tho' the protuberant Corners of *Glaſs* may be worn off ſomewhat, yet can they never be ſo adapted, but that ſome of them will get out beyond their Fellows. And tho' this Unevenneſs of the parts of *Glaſs* be not viſible to us, yet muſt we not therefore deny it, becauſe we know that our *Senſes* are not ſufficient to diſcover all the Affections of *Bodies*, and often miſtake in thoſe things, which *Reaſon* proves to be moſt clear and evident. A *Line* drawn upon a *Paper* doth appear *ſtrait*; which beheld through a *Microſcope* is found to be *crooked*, and to have many Inequalities.

III. *The moſt exactly poliſht Bodies are Rough.*

In like manner, there are many other *Bodies* which to our *Sight* and *Touch* ſeem to be abſolutely ſmooth, whoſe *Surfaces* notwithſtanding are made up of moſt thin prominent *Filaments*, with their *Intervals*, according to the demonſtration *Microſcopes* afford us of them. Thus Mr. HOOK hath demonſtrated the ſtrange aſperity and roughneſs of the *Point* of a *Needle*, and the ſmootheſt *Edge* of a *Razor*, *Micrograph. Obſ.* 1 & 2. Yea, all *Metals*, how poliſh'd ſoever, and *Lead* alſo, notwithſtanding its great compactneſs, repreſents great Aſperities to the Eye that conſults them, aſſiſted with a *Microſcope*.

IV. *Rough Bodies generally caſt ſomething of a white Colour.*

Bodies that have a *Rough ſurface*, commonly caſt a *whitiſh Colour*; but being moiſtned with *water*, they draw to a *blackiſh Colour*.

The *Reaſon* is, becauſe *Rough Bodies* conſiſt of many *Faces*, many whereof are ſo turned towards us, that howſoever the *Rays of Light* fall upon them, they reflect copious *Beams* to our *Eye*, and conſequently produce *Whiteneſs*. But when the *Surface* of a *Rough Body* is wetted with *water*, theſe *Unevenneſſes* or *Faces* are taken away, which before did reflect the *Rays* of *Light*, and conſequently muſt make it appear of a *darker Colour*.

V. *Smooth Bodies have one part more ſhining.*

Poliſht Bodies reflect the *Rays* they receive towards *one part*, which therefore becomes more *bright* and *ſhining* than the reſt, which rather appear *obſcure* and *darkiſh*.

Which proceeds from hence, becauſe the Expanſion or ſpreading of the *Rays* reflected from *Bodies*, is produced from the various Inclination and Eminence of their Parts. And therefore *Artificers* do cut and grind *Diamonds* into ſeveral *Angles* and *Surfaces*, that from them the Light might be variouſly reflected and diffuſed. Thus *Silver Veſſels*, when boil'd in a *white-waſh*, become white as *Snow*; but if after this, any part of them be poliſhed, they loſe their *whiteneſs*, and become *brown* and *darkiſh*; and like *Looking-Glaſſes*, reflect their *Rays* towards one place only; becauſe the eminent *particles*, which were the cauſe of their *Roughneſs*, are taken away by *poliſhing*, and therefore it cannot be otherwiſe, but that that *Light* which falls upon them, muſt be directed to one certain place. As we ſee in an *Iron Breaſt-piece*, which being poliſht, at ſometimes, appears very *bright* and reſplendent, and at others *dusk* and *dark*.

VI. *Why two poliſht Marbles are not without difficulty ſeparable from each other.*

Two Pieces of *Marble* exactly *poliſht*, do ſo cloſely cling together, that the lowermoſt of them by its own weight cannot fall down from the uppermoſt; no nor in caſe a much heavier weight be applied to it, to draw it down, nor can it be ſeparated from it, but by very great force.

The Cauſe hereof is to be fetch'd from the *weight* or *ſpring* of the *Air*, which preſſeth the two pieces of *Marble* together. Wherefore ſeeing that the *parts* of all *Bodies* that are here with us, are

are preſt againſt each other, by the ſuperincumbent *Air*, or the ponderous *Exhalations* and *Effluvia* of *Bodies*, it is obvious to conceive how much the ſimple Contact of the ſmall *particles* of any *Body*, according to their whole Surfaces, doth conduce to the cauſing and preſerving of the firmneſs of *Bodies*; not preciſely, becauſe the parts do touch one another; but becauſe, together with that Contact, there always is an outward Cauſe, *viz.* the *weight* of the *preſſing Air*, which is able to preſerve that Contact, till by a greater Force ſupervening they be ſeparated from each other.

VII. *Whence the Moſſineſs and Mouldineſs of Bodies doth ariſe.*

Some *Bodies* are very ſubject to grow *moſſy* and *mouldy*, as *Houſes* that are cover'd with *Tiles* or *Thatch*, the outſide of *Walls*, and *Ground* that hath not been tilled of a long time.

This *Moſſineſs* and *Mouldineſs* is cauſed, when the leſſer *particles* in their *Exhalation* out of *Bodies*, are ſeized by the Groſſer and Bigger, and are hindred from flying away and leaving the *Body*; for by this means, being mutually entangled, they ſtick faſt to the Surface of it, and turn into a kind of *Down*. Thus we find, that old *Trees* breed more *Moſs* than others, becauſe their *Juice* is not ſo well digeſted as to ſpend it ſelf all in *Branches* and *Twigs*; but becauſe of its weakneſs is ſtopt in its way, and covers the *Bark* of the *Tree* with a kind of *moſſy Down*.

VIII. *Why a Pumice-ſtone cannot be poliſht.*

A *Pumice-ſtone*, and ſeveral other ſorts of *Stone*, are not capable of being *poliſht*.

The *Reaſon* is, becauſe the *Pumice-ſtone* is a *porous Body*, and its *pores* are ſo wide, that the parts of it can never be brought by any Art to the ſmoothneſs of *poliſht Bodies*; but after all that can be done towards the *poliſhing* thereof will appear *rough* to the *Touch*.

IX. *No abſolute ſmoothneſs can be found in Bodies.*

From what hath been ſaid, we find reaſon to conclude, that there is no *Body* which can be ſaid to be abſolutely *ſmooth*. For, *Firſt*, the moſt *ſmooth* and *poliſht Bodies* have *Pores*, and conſequently ſo many Cavities, which are inconſiſtent with abſolute Smoothneſs. *Secondly*, The Artifice that is uſed for the *poliſhing* of *Bodies* being performed by *Whetſtones*, or very hard *Powders*, cannot but leave ſome Unevenneſs upon them, as we find by the *Microſcope* in the Surface of the moſt *poliſht Steel*, or the *ſmootheſt Edge* of a *Razor*. And ſo likewiſe it cannot be otherwiſe, but that *hard Powders*, uſed by *Glaſs-Grinders*, muſt leave ſtreaks and furrows, tho' imperceptible, to the unaſſiſted *Eye*. So that whatſoever is commonly ſpoken of the *ſmoothneſs* or *evenneſs* of *Bodies*, muſt only be underſtood with reſpect to the *Senſes*, but not abſolutely.

X. *Poliſht Bodies do more ſtrongly act and reſiſt, than Rough Bodies.*

Poliſht Bodies exceed *Rough Bodies* in the force of *Acting* and *Reſiſting*, as may be ſeen in *Knives* and *Swords*, which when *Ruſty*, cannot cut or penetrate *Bodies* ſo well, as when they are whetted and ſmooth.

The *Reaſon* is, becauſe *Rough Bodies* have their Surfaces very uneven, *ſome of their parts* jetting out, and others ſubſiding: Which Unevenneſs of the *Surface* is a great hindrance to *motion*, and is the cauſe why the *Bodies* that are ſtruck againſt them, do more faintly rebound from them. Thus we find, that a *Ball* will rebound much further from a *ſmooth*, than from a *rough Body*, which thoſe that *play at Ball* are very well aware of; and accordingly, neither can it be any wonder that a *ſmooth* and *ſharp Knife* doth cut better and more readily, than another that is all cover'd with *Ruſt*.

CHAP. VIII.

Of Tranſparent and Opake or Dark Bodies.

I. *Why ſome Bodies are more tranſparent than others.*

SOme *Bodies* are almoſt wholly pervious to the *Rays* of *Light*, and reflect but few of them: Others reſiſt the free paſſing of the *Beams*, and in ſome parts only ſuffer the *Beams* to pierce them.

This *Tranſparency* of *Bodies* conſiſts in the direct or ſtrait poſition and ranging of their *Pores*, without any reſpect had to the Neighbouring *Bodies*, whether they be continuous or contiguous, becauſe they make no change in the caſe. For ſuppoſing this *ſtrait poſition* of the *Pores*, a *luminous Object*, will as well affect our *Eyes*, as a *Colour'd* will, and impreſs its Image on our *Brain*. But when this *ſituation* of the *Pores* comes to be changed, then the *Beams* of the *luminous Body* are either not tranſmitted at all, or do not clearly exhibit the Image thereof, but confuſedly and diſformedly; becauſe they paſs through the *Body*, not in Rank and File, but in a tumultuary hudling manner crowd through it.

II. *Why Glaſs is more tranſparent than Paper*

Glaſs is more tranſparent than *Paper*, and admits a more free paſſage to the *Light*.

The *Reaſon* is, becauſe tho' in *Paper*, as well as *Glaſs*, there be *pores* which admit the *Light* coming upon them, yet are they not ranged after the ſame manner. For in *Paper* the *pores* are irregular and confus'd, by reaſon of the various entanglement of the *Threds* whereof it doth conſiſt, which obſtructs the *Action of the Light*, for thoſe *pores* which are open on the utmoſt Surface, as they go deeper, are obſtructed by croſſing *Filaments*. But in *Glaſs* there is ſuch an Arangement of *parts*, that the *pores* are all continued in a ſtrait Line, ſo that the *Light* moſt readily glides through them, according to that of the *Epicurean* Poet:

——*nor can the Beams of Light*
Through any Body freely reach our Sight,
Except the Pores in ſtraiteſt Lines be rang'd,
As they're in Glaſs——.

For *Glaſs*, when it was firſt made, and was yet in fuſion, the *particles* of the *Fire* piercing it every way, formed innumerable *pores* in it, through which the *Globuli* of the *ſecond Element* finding a free paſſage, are able to tranſmit the Action of *Light*, which conſiſts in their preſſion, every way in *ſtrait Lines*.

III. *Tranſparency may be acquir'd ſeveral ways.*

There are ſeveral ways whereby *Tranſparency* may be produced: *Firſt*, By *melting*: Thus we find that *Snow* and *Butter* by being melted, become tranſparent. *Secondly*, By the intruſion of ſome proper *Body*, by means whereof a due poſition of the *Pores* is introduc'd: Thus *Paper* anointed with *Oil* tranſmits the *Light*, and is made *Diaphanous*. *Thirdly*, By Reſolution: Thus we ſee that the *Waters* or *Spirits* diſtill'd from *Opake Bodies*, as of *Roſes*, *&c.* are tranſparent. *Fourthly*, By *Concretion* or *Coagulation*, by which means the *Diamond* and

and *Crystal* attain their perspicuity. *Fifthly*, By *polishing* and *wiping off the Dust*: Thus *Glass* by being *polished*, and after it is polished by being *dusted*, becomes *transparent*, and affords a free and undisturbed passage to the *beams* of *Light*.

IV. *How Glass is made more dusk and obscure, by the addition of new parts.*

The *perspicuity* of *Glass* is diminished by the same degrees, as it increaseth in Thickness and Bulk.

The Cause whereof cannot be assigned to ought else, but the *Inequality of the Pores*: For seeing that *Glass* is not altogether *transparent*, but consists of many *thick parts*, which reflect the *Beams* of *Light*; it cannot be otherwise, but that many of its *pores* must be obstructed by the addition of new Matter, and consequently the *Action* of *Light* hindred. As we see that a man may, through the joyning of his *Fingers*, perceive Objects; but if he lay the Fingers of his other *Hand* athwart them, they will stop those little *slits* or gaps through which he could see Objects before. In the same manner, tho' a thin *Glass* does readily transmit the *beams* which fall upon it; yet will it stop and hinder the Sight, if it increase considerably in thickness, because its *pores* by this means are interrupted and are made unequal. And it is evident, that the Inequality of the Disposition of the *parts* alone is sufficient to render that *Opake*, which before was *Diaphanous*. Thus we find that the *Grains* of *Indian Sand*, beheld through a *Microscope*, are not only pellucid, but sparkle like *Diamonds*; but when by being heaped together they can no longer give free passage to the *Light*, they shew *Opake* or *Dusky*.

V. *How Vintners fine their VVines.*

It is a thing common with *Vintners*, to *fine* their *Wines*, that is, to make them clear and pellucid, by means of *water-Glue*, ordinarily called *Izing-glass*, and the *whites of Eggs*; making use also sometimes of *Alabaster*, and calcin'd *Flints*, for the same end.

For the first of these, consisting of *Viscous* and *Tenacious parts*, do easily entangle the *fæculent* parts of the *Wine*, and sink with them to the bottom: And the *other*, have a Precipitating force or virtue; and therefore entring the *Pores* of the *Wine*, do precipitate the more dreggy parts of it. In like manner they correct *Ropy-VVines*, by adding to them *burnt Alom*, *Quick-lime*, *Plaister of Paris*, *Salt*, and the like; for all these produce a new Fermentation in the *Liquor*, and so cause a separation of the grosser parts, which are sent down to the bottom. And by this means the *VVine* recovers its former consistence and pellucidity.

VI. *VVater is more opake than a Mist.*

Tho' *VVater* seem transparent to the *Eye*, yet is it less pervious to the *Light*, than a *Mist*: For if a *man*, from the top of an *high House* or *Tower*, look down towards the *Earth*, he will be able to perceive it through a *Mist*; whereas he finds that his *Eye-sight* cannot pierce to see the bottom of a *River*, where the distance is as great from the Surface of the *River* to the bottom, as from the said *high Tower* to the ground. And therefore *Divers* witness, that after they are got 12 or 15 *Cubits* under *water*, they can neither perceive the *Sun*, nor any thing else. Which is an evident Argument, that the *VVater* is an *Opake Body*, and much more dusky than a *Mist*.

The Reason hereof in *VVater* seems to be the Thickness of its *parts*; which being irregular, and of unequal *Figures*, easily hinder the *Globuli* of the *second Element* from passing through them in strait Lines. For we must conceive a *Body* to become *Opake*, when the said *Globuli* cannot pass through it, but by oblique ways, and when their course is stopt by thwarting *particles*. Now a *Mist* is more transparent than the *VVater*, because it consists of thinner parts, and such as are more ready to comply with the motions of the *subtil Matter*, and easily make way for them: For tho' the parts of the *Mist*, as well as the *VVater*, be irregular; yet they differ in the *Magnitude*, because the *particles* of a *Mist* are more fine and subtil, and not so closely entangled, as those of the *water*. Whence it is that the *Globuli* of the *second Element* move them with more freedom, and more easily thrust them out of their places; which is the true Reason why a *Mist* doth less oppose the transmission of *Light*, than *VVater* doth.

VII. *Why many Liquors are opake.*

VVine, *Milk* and *Blood*, with many other *Liquors*, are *Opake*.

And the Reason is, because they are not *pure* and simple *Liquors*, but are throng'd with many *Heterogeneous Bodies*. It is a thing very notorious, that *VVine*, when it is distill'd, leaves many *Bodies* behind, which will not rise in *Vapours*. And this is the reason of the great clearness of *Spirit of VVine*; for being by Distillation freed from all its *Heterogeneous parts*, which were an hindrance to the free passage of the *Rays* of *Light*, it becomes wholly transparent, and that in the highest degree. *Milk* also is *Opake* for the same reason; for we find that when the *Curds* are separated from it, the *VVhey* is in a great measure *Diaphanous*. And the same is to be said of *Blood*, and other such like *Liquors*, which never appear thick or troubled, but when some strange Bodies are mixed with them, which obstruct or come athwart their Pores.

VIII. *How Liquors are made clear and transparent.*

Beer, *Ale*, and other Liquors, after *fermentation* become clear, and are not thicker or more troubled at the bottom, than at the top.

And this, because the Matter of the *second Element*, moving in the *pores* of *Liquid Bodies*, do continually drive the *particles* of the *third Element* out of their places, till they have so disposed of them amongst others, that they do no more resist their *motion*, than those others do; or if they cannot so dispose them, till they have wholly separated them from the rest. Thus we see that *New Wine* doth not only cast some of its dregs upwards towards the Surface, and precipitate others of them downwards (which might be attributed to the Lightness or Heaviness of the *particles* so separated) but also to the Sides of the *Vessel*. And the same estimate is to be made concerning *pure Liquors*.

IX. *Why Urine is sometimes clear and transparent.*

So for the most part *Urine* is clear and transparent, whilst the *Heat* helps to keep the *pores* more lax and open, and consequently leaves a more free way for the *Light* to pass: But when either the *pores* are contracted by *Cold*, or stopt with various *little Bodies*, they are the cause of the Opacity of the *Urine*. For indeed, there are but very few *Liquors* which are without any *Opake particles*.

And

X. *Why our hands are commonly more dirty in Winter, than in Summer.*

And for the ſame Reaſon it is, that our *Hands*, during the *Winter*, are more dirty; becauſe the *particles* that ſhould exhale through the *Skin*, continue ſticking under it, and that becauſe of the greater conſtriction of the *pores*, ſo that the exhaling Matter is hindred from flying away into the *Air*: Whereas in *Summer time*, when all the *pores* are open, all theſe groſs Exhalations are carried up into the *Air*, and conſequently leave the *Hands* clean. Wherefore in *Cold weather* it is good to waſh the *Hands* with *warm water*, to help to open the *pores*.

XI. *Why Cryſtal loſeth its perſpicuity, when caſt into the Fire.*

Cryſtal, if it be caſt into the *Fire*, or for a Minute or two be cover'd with *hot Aſhes*, it loſeth its *Diaphaneity*, and ſeems to degenerate into a quite different *Body*; neither can it afterwards, by any known Art, be reduced to its former perſpicuity.

Which can only be attributed to the *particles* of *Fire*, which violently ruſhing into the *pores*, do break their order, and conſequently produce a new ranging of the parts. Now this confuſed diſpoſition of the Parts, deſtroys perſpicuity; as ſhall be ſhewed more at large, when I come to treat of *Qualities*.

XII. *How it comes to paſs that two clear Liquors mixt together conſtitute a black Body.*

It has been found by Experience, that from the mixture of 2 clear Liquors, a *black Body* doth ariſe: For the Infuſion of *Galls*, which is clear, being mixed with a ſolution of *Vitriol*, makes *Ink*.

The Reaſon whereof is, becauſe the *particles* of both theſe *Liquors* being mixed together, do ſo intimately cloſe and unite, that by the cloſeneſs of their ranging, they hinder the paſſage of the *Beams* of *Light*. For in either of theſe *Liquors* there are certain little *Bodies*, which when joyned together, neither tranſmit the *beams* of *Light*, nor ſuffer them to reflect from the *Body*, but do, as it were, wholly ſwallow them and keep them Priſoners. But if you add to the *Ink*, *Aquafortis* or *Spirit of Vitriol*, it will become clear again, like *Spring water*; becauſe the *particles* of this new infuſed *Liquor*, do ſeparate the contiguous *Bodies*, and open the ſhut up *pores*. But if *Oil of Tartar per Deliquium* be added to the *changed Ink*, it will be reſtored to its former *Blackneſs*; becauſe *Oil of Tartar* joyns it ſelf with the *Spirit of Vitriol*, and the *particles* of the *Galls* and *Vitriol* do again embrace each other. It is alſo from the ſame Cauſe that *Spirit of Wine*, in which *Anniſeed* hath been boil'd, when mix'd with *water*, yield a *white Colour*; and *Oil of Tartar*, when mixed with *water*, becomes troubled and opake; that is, becauſe the order and diſpoſition of their Parts is troubled, and the paſſage of the *Æthereal matter* hindred, by little ſuper-added *Bodies* that obſtruct the *pores*.

XIII. *The Reaſon of the variety of Colours ariſing from the mixture of various Liquors.*

Hence it is that when we write with the clear and tranſparent Infuſion of *Vitriol*, the Letters do not appear at all, except that the Paper hath been done over with the Infuſion of *Galls*; but a *Pen* dipt in the *Spirit of Vitriol* will efface theſe *Characters*, which will appear again when drawn over with a Pen dipt in the *Oil* or *Liquor of Tartar*. And the cauſe is much the ſame in other *Colours* produced from the mingling of 2 clear *Liquors*. Thus the *Salt of Tartar* diſſolved *per Deliquium*, being poured into a ſolution of *Calcin'd Tin*, gives a *blew Colour*; the ſame added to a ſolution of *Lead* in diſtill'd *Vinegar*, yields a *white Colour*; and being dropt into an Infuſion of *Mercury Sublimate*, affords a *yellow*; *Antimony* Calcin'd with *Nitre*, and boil'd in common *water*, leaves the *water* that is ſtrain'd from it *clear* and *tranſparent*. All which diverſity proceeds from the various diſpoſition of the *particles* whereof theſe *Bodies* are compounded, which cauſes the *Rays* of *Light* to receive a different Reflection from their ſeveral *Surfaces*.

CHAP. IX.

Of Bodies that are Bended and Preſſed together.

A *Bow*, made of *Steel* or *Wood*, being bent, returns to its former ſtate.

I. *What is the Reaſon that a bent Bow, as ſoon as ſlackned, returns to its former ſtate.*

The Reaſon whereof I ſuppoſe to be, becauſe the *pores* of the *Bow*, by the *bending* of it, becomes ſo narrowed, that the *ſubtil Matter* cannot freely paſs through them; and therefore puſhing againſt them with greater force than ordinary, ſtrives to make its way through them, as formerly. Now this may be done ſeveral ways; for if we conceive the *pores* of the *Bow*, before it was bent, to have been of an even wideneſs from beginning to end, but that by being *bent* the ends of the ſaid *pores* are narrowed, it is evident that the *ſubtil Matter*, which paſſeth freely through that part of the *pores* which is *wideſt*, when it comes to the narrow Extremities, will endeavour to diſentangle it ſelf, and paſs further. But if the *pores* of the *unbent Bow* be ſuppoſed of a round *figure*, and that by the *bending* of it they are reduced to an *Elliptical figure*, the *ſubtil Matter* will exert its endeavour, to bring them to their former *round figure*, and conſequently will reſtore the *bent Bow* to its former ſtate. For tho' the *Globuli* of the *ſecond Element*, with reſpect to their *bulk*, are but of little force to ſhake the ſides of the *pores*; yet becauſe they continually croud in great numbers into the *Cavities* of the *Bow*, ſtriving to make their way through them, all their Forces being joyn'd, and conſpiring to this end, are ſufficient to effect it.

II. *Why Wires and the Boughs of Trees, that are bent, return to their Natural poſture of themſelves.*

And it is for the ſame Cauſe that *Iron-wire*, made to wind ſpirally in Rings, like a *Serpent*, and ſhut up in a *Box*, as ſoon as the *Box* is opened, it leaps out of the *Box*, like a *Serpent*, ſhooting it ſelf at ſome body. Thus alſo the *bended Boughs* of *Trees*, as ſoon as they are let go, fly back with great force and violence, ſo as to carry vaſt weights up with them: Becauſe by this bending the parts of the *Boughs* are compreſt together, which upon the impulſe of the *ſubtil Matter*, ſtriving to enter the compreſſed *pores*, are driven to their former ſtate and poſture.

III. *Some Bodies upon their being bent, rebound or fly back more ſtrongly, others weakly.*

On the contrary, a *ſoft Plant*, ſuch as is the *Elder*, flies back but a little; a *Hazel tree*, which is harder, more; becauſe the foreſaid *ſubtil matter* paſſeth with more eaſe through the open *pores* of the former, and with greater difficulty through the ſtraiter *pores* of the latter. Thus *Glaſs* that is bent, returns with greater force; becauſe the parts of it are not joyned by the mutual entangling of their *Branchy particles*, as thoſe of *Plants* are, but only by their *Surfaces*: And therefore when the *figure* of the *pores* of *Glaſs* is changed, the *ſubtil matter* exerts a more forceable impulſe to reſtore the ſame. A Proof whereof we have in a *Plate* of *Iron*, which by being much hammer'd, acquires

this force or ſpring to fly back. Thus likewiſe the *Air* it ſelf, by being compreſt and pent in *Pneumatick* or *Hydraulick Pipes* or *Inſtruments*, when it is left to its liberty again, it diſchargeth the *bullets* or *water* with as much force, as before it had been pent in and compreſt; and all this from the attempt of the *ſubtil Matter*, to reſtore the changed *pores* to this former ſtate and figure.

IV. *Why all the wavings this way and that way, take up the ſame ſpace of Time.*

A *Cord* or *String* faſtned at both ends to fixed *Bodies*, being forced from its ſituation, runs out and returns, or waves this way and that way in the ſame meaſure of time, tho' it doth not always meaſure the ſame ſpace of place.

The Reaſon is, becauſe, as in a *Body* that hangs down, the ſeveral *motions* of the ſeveral Excurſions are equal to the time of their Returns, by the Altitude of that *Circle*, the *Arcs* whereof are deſcribed by the hanging *Body*: So in like manner in a ſtretched *Body*, all the Moments of time wherein the *middle part* of the *String* waves out one way, are equal to that one time, wherein the other Extream, in caſe it were cut looſe, would ſtrait paſs through the whole length, and come to the place of the other, to which the unchanged force would ſtill draw it back.

V. *Why the Excurſions of a ſtring, are not equal to the degree of its being ſtretched.*

If you demand, why a *String* that is as long again, if it be equally ſtretched, doth make its Excurſions as ſlow again as another: But if the *String* be ſtretched as much again, it doth not make its Excurſions as ſwift again; but to the end it may do ſo, the force of the ſtretching muſt be 4 times as great.

I Anſwer, that foraſmuch as all the *Excurſions* of every *String*, be they of what length they will, are equal to one and the ſame ſtraight Trajection, the Trajection in the *former* caſe, muſt needs be made in a double proportion of time; becauſe a double Space is taken to be run through by the ſame motive *Force*: But in the latter caſe it cannot; becauſe when we take three equal things, *viz. Time*, *Space*, and the *motive Force*, it muſt neceſſarily follow, that ſuppoſing the ſame Space to remain, as much as the time is diminiſhed, ſo much the motive virtue muſt increaſe; and that there be the ſame proportion of the ſpace to the time, as there is of the motive virtue to the ſpace: Therefore it muſt follow, that if the ſpace be in ſuch a proportion to the time, as 2 to 1, the force muſt be to the ſpace, as 4 to 2; and therefore muſt not have the proportion to time of 2 to 1, but of 4 to 1.

VI. *Why Sticks break after that they have been long bent.*

Some *Bodies* that have continued long *bent*, do break, when we endeavour to reduce them to their former poſture; as we find in ſome *Sticks*, which break whenever we go about to ſtraiten them again.

The *Reaſon* whereof is, becauſe the *ſubtil Æther*, whilſt it endeavours to ſeparate the *particles* of *Bodies* that reſiſt its motion, muſt not only overcome the Reſiſtance of them, but of the *Bodies* that ſurround it. And foraſmuch as every thing endeavours to continue in the ſtate wherein it is, and that *Bodies* which have been once put into motion, do continue in the ſame; ſo it is that the *ſubtil Matter* cannot ſhake them, without ſuperadding more force to them, and increaſing their ſtrength; and ſo it comes to paſs, that daſhing more ſtrongly againſt the ſaid parts, it altogether ſeparates them from each other.

VII. *A Bow that continues long bent, at laſt loſeth its force of returning to its former ſituation.*

A *Bow* that hath been long *bent*, eſpecially if it be made of *Wood* or *Steel*, doth in proceſs of time loſe its force of flying-back, and continues in the ſame ſtate, to which by *bending* it hath been reduced. A long Plate of *Lead*, bent in manner of a *Bow*, doth not fly back at all, but continues in the crooked ſtate in which it is put.

The Reaſon why a *wooden Bow*, that hath been long bent doth not fly back, is, becauſe its parts are not ſo hard, but that the *ſubtil Matter* can eaſily form new *pores* in them for its own paſſage; but a piece of *Lead*, bent like a *Bow*, cannot ſtart back: For ſeeing that the parts of *Lead* are ſoft and flexible, they do eaſily ſuffer themſelves to be penetrated; ſo that the *ſubtil Matter* can eaſily form new *pores*, and being able to paſs freely, doth not make any attack upon the parts, whereby it might cauſe them to fly back. For as *drops* of *Water*, falling perpetually, do make an impreſſion even upon the hardeſt *Stones*; ſo by the continual impulſe of the *ſubtil Matter*, againſt the ſides of the *Oval pores* in the bent *Lead*, they are adapted and accommodated to the free admiſſion of the ſaid *particles*, ſo as to let them go through without any Reſiſtance.

VIII. *Why a Bullet doth more penetrate a Body at a diſtance, than one which is nigh to it.*

It is obſerved by ſome, that a *Bullet* diſcharged from a *Gun*, doth more penetrate a *Body* at 100 Foot diſtance, than at 10 or 20.

The Reaſon whereof is, becauſe the *Bullet* being ſo ſoon beaten back, hath not ſpace enough to perform ſo ſtrong an effect: Something in the ſame manner, and for the ſame reaſon that a *Hammer* leſs flattens a *Bullet* when lying upon an *Anvil*, than when it is laid on a *Cuſhion*; as before was mentioned, *Chap. 6. Of hard and fluid Bodies.*

IX. *Compreſt Liquors take up leſs Room, than thoſe which are put into Veſſels, where they are not pent up.*

It hath been obſerved, that when a *Veſſel* fill'd with *Liquor* is emptied into *Bottles*, and afterwards the *Liquor* is poured out of them into the *Veſſel* again, it will not fill the *Veſſel* as much as before; and that it is more conſpicuous in *Wine*, than in *Water*.

The Cauſe whereof is, becauſe the *Liquor* is not ſo much compreſt in an open *Veſſel*, as in *Bottles*; and becauſe in the former the *Liquor* meets with nothing almoſt, but parts of its own Nature; whereas in *Bottles*, the parts of the *Liquor* meet more with the parts of the *Bottle*, which ſo keeps them in, and compreſſeth them, that they cannot diſplay themſelves, as otherwiſe they would. As the *Liquors* are compreſt by the Sides of the *Veſſels* wherein they are contained; ſo likewiſe on the other hand are *Bodies* alſo compreſt by the *Liquors* that are in them, but yet ſo as to be equally compreſt in all the parts of them; becauſe the parts of the *Matter* are kept in by each other in Equal poiſe, neither are they more preſt in one place than in another.

X. *Why a Bellows held with the upper part under water, cannot be opened or diſplayed.*

For the ſame *Reaſon* it is alſo, that a pair of *Bellows* with the Sides of it clapt together held under *water*, the *Nuzzle* of it ſtanding out, cannot be diſplayed or opened; foraſmuch as the ſides of it are compreſt by the ſurrounding *water*, which will not give way, no not tho' great force be made uſe of for that purpoſe, eſpecially if the *Bellows* be ſomewhat deeply ſunk under *water*. Thus if you take a *Veſſel* full of *Quick-ſilver*, and faſten to it a long *Pipe*, the top whereof ſtands out of the *Water*, it will be ſo compreſt at the bottom

bottom of the *VVater*, that it will cauſe the *Quick-ſilver* to riſe ſomewhat in the *Pipe*.

XI. *VVhy the Air breaks forth with ſuch violence out of thoſe Pneumatick Veſſels, wherein it hath been compreſt.*

Air that hath been compreſt in a *Pneumatick Engin*, breaks forth thence again with extream Violence; as is ſeen in thoſe *Engins* which caſt up *water* to a great height, or ſhoot *Darts* or *Bullets* at a great diſtance.

Some take the Reaſon hereof to be, that the *Air* being ſtrongly preſt upon, is received into ſome empty Spaces, which before ſeparated the parts of *Air* from each other. But ſuppoſe it to be ſo, what is the Reaſon that when the Hole of the *Pneumatick Veſſel* is opened, the *Air* breaks forth ſo violently? For if every part of *Air* retire it ſelf into thoſe empty Spaces, and preſerves its former Extenſion, where is the Compreſſion? And what is it makes the *Air* leap back with ſo much violence, if by being received into thoſe empty Spaces, it does ſuffer no Violence?

The Cauſe therefore of this *Elaſtick virtue*, is, becauſe the *Air* being thus compreſt, its parts are not capable of dilating themſelves as formerly: For being all of them flexible, and moving independently on their *Neighbours*, they muſt every one of them have, as it were, a little *Sphere*, which may be ſufficient for them to perform their *Circular motion* about their own *Center* in. But being compreſt, they can have no ſuch *Sphere* or *Space* to move in, ſince every one of them enters into the other place, and ſo hinder one another. And whereas the force of the *Globuli* of the *ſecond Element* continues ſtill to be the ſame, and ſhakes the parts of the *Air*, as much as before; they with their Extremities hitting againſt each other, and driving one another out of their places, at laſt joyn their forces, and make a general onſet to deliver themſelves from the ſaid Compreſſion, and procure more room for themſelves.

Hence it is, that the *Air* which is compreſt in a *Pneumatic Veſſel*, whereof I have given the *Figure* in the *Sixth Part of my Inſtitution*, *Chap.* 14. having *water* at the bottom of it, doth violently break forth, mounting up to a very great height.

XII. *How it comes to paſs, that the Air may be compreſt in a Leaden or Pewter Veſſel, but not in a Glaſs.*

Water contained in a *Glaſs* cannot be compreſt, at leaſt ſenſibly; which yet may eaſily be done, when it is in a *Veſſel* of *Lead* or *Pewter*.

The Reaſon is, becauſe the Compreſſion of the *water* is always performed by the Expulſion of ſome *ſubtil Matter*, which lay hid in the *pores* of the *compreſt Body*. Now becauſe the *Air*, which is contained in the *water*, cannot pierce through the *pores* of the *Glaſs*, as it can thoſe of *Lead* or *Pewter*; therefore this is the Reaſon, why *water* is capable of being compreſt in a *Veſſel* of *Lead* or *Pewter*. Thus we ſee not only, that *water* is ſqueezed out of *Wool*, *Sponges*, and other ſuch like *wet Bodies*; but likewiſe out of *Green-wood*, and *Air* out of *Dry-wood*, when they are compreſt by being put into *water*; as is apparent from the *Bubbles* ariſing to the Surface of the *water*.

XIII. *A Bladder that is blown up with Air, being compreſt, returns to its former ſtate of inflation.*

A *Bladder* blown up, being compreſt, riſeth again.

Becauſe the *particles* of the *Air*, which are ſhut up in the *Bladder*, being in continual *motion*, and whirling about their own *Centers*, they conſequently cannot, without difficulty, ſuffer themſelves to be compreſſed; and therefore as ſoon as the preſſion ceaſeth, they are extended again by the *Agitation* of the *ſubtil Matter*, and conſequently dilate the *Bladder*, as before.

XIV. *VVhy the VVind that is pent up in a narrow ſpace, blows more violently.*

From the ſame Cauſe it is, that a *Wind* breaking forth from the *hollow* of *Mountains*, doth with ſo much violence ſtorm in the open *Air*; and that a *River*, where its *Banks* are narrow, runs with the greater force and ſwiftneſs: For the *wind* and *water* being compreſſed in thoſe more narrow Spaces, do endeavour to deliver themſelves from the Force that is upon them.

XV. *VVhy Leather that is extended by force, returns to its former length.*

Hence it is likewiſe, that *Cloth* and *Leather* that hath been violently ſtretched out, return to their former Brevity; becauſe many of their *pores* being ſtraitned by that Extenſion, cannot ſuffer the *ſubtil matter* to paſs through them, without a forceable and violent *motion*: Wherefore, as ſoon as the ſaid violent Extenſion doth ceaſe, the *pores* return to their former laxity; and the *particles* that ſurround the ſaid *ſtraitned pores*, by means of the *ſubtil matter*, are reduced to the bounds of their former Extenſion.

XVI. *VVhy the drawing of ones Finger about the Brim of a Glaſs, makes the water contained in it to leap up.*

A *wet Finger* drawn about the Brim of a *Glaſs* full of *water*, or any other *Liquor*, firſt makes the *water* to wave a little, and to riſe up in a ſmall *Dew*, and being continued, will cauſe the *water* to leap over the Brim in great *drops*.

The Cauſe whereof is, becauſe by this drawing of the *Finger* round the Edges of the *Glaſs*, the hard, but flexible parts of the *Glaſs* are preſſed, and conſequently the *pores* ſtraitned, ſo as that they are no longer able to make way for the *Celeſtial matter* to paſs through them. But as ſoon as the *Finger* is removed to other parts of the brim of the *Glaſs*, the *ſubtil matter* preſently reduceth the *pores* of the before preſſed part to their former wideneſs: And from this repeated compreſſion of the *particles* by the Finger, and their Extenſion by the entring of the *ſubtil matter*, there is firſt cauſed an *agitation* of all the parts of the *Glaſs*; afterwards a ſwelling and waving of the *Liquor*; and laſtly, the leaping up of the drops of it over the *brim* of the *Glaſs*.

XVII. *The Dilatation or Coarctation of the pores of a Body, doth conduce to the Elaſtick force of it.*

The *Coarctation* and *Dilatation* of the *Pores* of a *Body*, do much contribute to its *Elaſtick force*.

Thus if we wipe the *Convex ſurface* of a *bent piece* of *Glaſs* with a *hot Cloth*, it will by this means become the more *bent* and *crooked*. But we ſhall find the effect contrary, if we waſh the *Concave ſurface* with *Hot-water*, or wipe it with a *Hot-cloth*, for then its *Crookedneſs* will be diminiſhed; becauſe the *particles* of the *Fire* do dilate the *pores* of the *Glaſs*. This being much the ſame effect which we find, when having fill'd a *Glaſs Vial* with a long and narrow *Neck*, up to the middle of the *Neck* with *water*, we dip the ſame in *Hot-water*; whereupon we ſhall find that the *water* in the *Glaſs* will ſink a little; becauſe the *heat* hath dilated the *pores* of the *Glaſs*, and thereby made the *Vial* a little wider: But if you let it continue in the *Hot-water*, then the *water* which is in the *Vial* being heated likewiſe, will riſe higher again: But the contrary will happen when you dip the *Vial* into *Cold-water*; for the *pores* of the *Glaſs* being ſtraitned by the Coldneſs of the *water*, the *Liquor* in the *Glaſs* will riſe higher.

Little

XVIII. *What is the Reaſon why Glaſs Drops, when one end of them is broke off, the whole immediately breaks into ſmall Duſt.*

Little bits of *ſolid Glaſs* are brought out of *Pruſſia*, which are commonly called *Glaſs-drops*; the *figure* of them ſomewhat reſembling a long *Olive*, with a crooked Neck, not much unlike the *Retorts* Chymiſts uſe, ſave only that it is ſolid and without any Cavity, as is expreſt in the *figure* A B. Theſe *Glaſs-drops* were formerly made of a hard and thick ſort of *Glaſs*, but are now made of *Cryſtal-Glaſs*, which being melted, and drawn out of the Melting-Pot with a *Glaſs-Pipe*, and being dropt into a *Pail* of *water*, becomes formed into theſe *Drops*, becauſe of the *Clammineſs* of the *Matter*. If theſe *Drops* be let fall into *warm-water*, the *Drops* will be better and more eaſily formed. Now it is a very wonderful thing to ſee a ſolid piece of *Glaſs*, which ſcarcely can be broke with the repeated ſtroaks of a *Hammer*, yet when broke off a little above the end or point of it, or being *filed* in the more diſtant parts at 1 or 2, doth immediately break into ſmall Duſt, to the great admiration of the *Spectators*. When indeed the end or point of it 3 is broke, it does not always fall into *Duſt*; but if the thicker part of the Neck 4 is broke or ſnapt off with a pair of *Pincers*, the whole Drop flies into ſmall Duſt, not without ſome noiſe.

Figure 7.

This notable Effect cannot be aſſigned to any other Cauſe, than the *ſubtil matter*, which upon the breaking off of the Point 4, doth immediately ruſh into the *pores* of it with ſo much violence, that finding no out-let, it exerts its force upon the Neck of the *Drop*, and breaks it into the fineſt *Powder*. For ſeeing that this *Glaſs*, like a Drop, is at firſt of an *Oval figure*, and afterwards pointed, and at firſt drops into the *water* in greater quantity, and afterwards in a fine *ſtring*, the *pores* that are in the Point of it, muſt needs be uniform and like one another; whereas thoſe that are in its other parts muſt be as various, as being more remote from the *ſurface*: For the deeper they are in the *Glaſs*, the wider they are; and this, becauſe the Point being ſo thin and ſlender, is uniformly condenſed by the *water* inward and outward, and perforated by the *ſubtil matter*; whereas the thicker parts have their outſides cooled and condenſed, before their inſide. The utmoſt Point therefore 3, may be broken either with a *Hammer*, or with the *Hand*, without any pains or wonder; but the other parts 4, or A, cannot be pierced with a *Bodkin* or *File*, before that the whole Drop fly into *Powder* with a great noiſe: For becauſe of the ſtraitneſs of the *pores* that are in the *ſurface* of it, and the dilatation of thoſe that are about the middle, the *ſubtil matter* ruſhing vehemently from the middle of the *Glaſs* to the outſides of it, daſheth away the *partieles* of the *third Element*. For Experience teacheth, that any *Glaſs* that is cooled after this manner doth fly to pieces in ſmall *particles*: For the parts of the *Glaſs* that are about the midſt of it, being wider, and growing narrower, as they approach to the *ſurface*; it muſt follow that the *ſubtil matter* penetrating the more narrow *pores*, doth daſh againſt them with that violence, that it makes the *Glaſs* fly into ſmall *Duſt*.

XIX. *A Glaſs Drop being heated again in the Glaſs-makers Furnace, and ſuffer'd to cool by degrees, doth not, when broke, fly into Duſt.*

But if this *Drop* be afterwards heated again in the *Furnace*, and ſuffer'd to cool by degrees, the now mentioned wonderful effect doth not follow; becauſe in this caſe the foreſaid *Pores* are all uniform: According as we find it happens in *Steel*, which being a ſecond time heated in the *Fire*, doth thereby acquire uniform *pores* throughout, ſtill retaining the Hardneſs it had before. Wherefore alſo when the *Point* of it is broke off, there is no reaſon for its breaking into pieces, becauſe the *ſubtil matter* finds its way open through the uniform *pores* of it. But the contrary happens, when being put into the *Fire*, it be not ſuffer'd to become red hot; for tho' then when the Point 3 is broke off, or the part 4, it doth not fly into *Powder*; yet if the breach be made nearer to A, the ſame effect will follow by the Reaſon before given.

XX. *Preſſed Bodies exert a greater force at the beginning of their Dilatation, than at the end of it.*

It is obſerved, that all *Bodies* which are dilated by an *Elaſtick virtue*, do exert a greater force at the beginning of their *Dilatation*, than at the end of it.

The Reaſon is, becauſe theſe *Bodies*, at the beginning, are ſuppoſed to be more compreſt, than afterwards when they are more dilated. Now it is plain, that whilſt they are more compreſt, their *Elaſtick virtue* or *Spring* is ſo much the ſtronger, and they do the more endeavour to dilate themſelves, ſo that they muſt needs exert a greater force at the beginning of their *Dilatation*, than in the progreſs of it.

The

The Second Part OF THE HISTORY OF NATURE. OF QUALITIES.

CHAP. I.

Of Qualities in General.

I. *Qualities, as they are commonly explained, are altogether unintelligible.*

A *Student* of *Philoſophy* ought to abhor nothing more than to aſſert things which he doth not underſtand, or to endeavour the Demonſtration of what he cannot *define*. But yet there be many that are guilty of this fault, who endeavouring to defend the opinion of ſome of the *Antients* concerning *Qualities*, do attribute ſuch a Nature to them, which we can have no conception of. For of what uſe is it to tell us, that a *Quality is that whence things are ſaid to be* Quales *or ſuch like?* What *Old Woman* is there that doth not know as much? Is there any *Country Fellow* ſo blockiſh, that doth not know that by *Whiteneſs* things are made White, and by *Redneſs*, Red? They would do much better to acquaint us wherein preciſely the Nature of a *Quality* doth conſiſt, how it doth affect the *Subject* it belongs to, and after what manner it is diffuſed through the ſame. Let the *Peripateticks* therefore in good earneſt tell us, what *Repreſentation* they frame in their *Minds* of a *Quality*, and trouble us no more with their *Words*, which ſerve only to darken and ſully *Truth*. Is *Quality* any thing *Phyſically*, or really diſtinct from the *Subſtance* wherein it is? Or is it ſuperadded to the things that are denominated from it, as ſome new *Entity?* Let them therefore explain its Genuine *Nature* to us, and do it in ſuch a manner, as that what they expreſs in *words*, may be intelligible to us. If they cannot do this, which indeed I ſuppoſe is a thing impoſſible for them, why do not they quit theſe frivolous *Qualities*, and following the *Laws* of *Nature*, eſpouſe more *Intelligible Principles?*

II. *Wherein the Nature of a Quality doth conſiſt.*

What is more Intelligible than *Quantity*, *Motion*, *Situation*, *Figure* and *Reſt?* By which all natural effects may be made out, even the moſt abſtruſe and difficult of them. A *Watch* is moved, and without any outward force, meaſures and ſhews the *Hours*. A *Key* locks a *Door*, and opens it. Is there any neceſſity to conceive a faculty in a *VVatch*, that may ſet its *VVheels* a going? Or in a *Key* any thing really diſtinct from it whereby the *Lock* is opened? What *Man* in his wits will not confeſs that it is more conſonant to Reaſon, to attribute the conſtant motion of a *VVatch* to *the Steel Spring*, *the diſpoſition of the VVheels with their figure and contexture*; and the power of ſhutting and opening that is in a *Key*, to the *Figure* and Ranging of its Parts; than to have recourſe to *Qualities*, which they can never *explain* nor *conceive*? But this is to run out beyond what I have here deſigned, which is not to aſſert the Nature of *Qualities* by *Arguments*, but to confirm the ſame by *Experiments*.

III. *There are no Qualities in the Sun that are really diſtinct from it.*

The *Sun* hath a power to harden *Clay*, ſoften *VVax*, melt *Ice* and *Butter*, to reſolve *VVater* into *Vapors*, to whiten *Linnen*, to tan the *Skin*, to ripen *Fruits*, to hatch the *Eggs* of *Fowl* and *Silk-worms*, and ſometimes to produce I know not how many various effects. All which are not any diſtinct *Powers* or *Qualities* in the *Sun*, but only the reſults of its *Heat*, which according to the different Texture of *Bodies*, and according to the different concourſe of *Cooperating Cauſes*, is variouſly determined.

IV. *The Difference of Bodies proceeds from the different Figure and Contexture of their Parts.*

The Pureſt *Spirits* of *VVine*, when joined with the moſt highly *Rectified Spirit* of *Urin*, become united together in the appearance of *Snow*, which is cauſed by nothing elſe but a new *Texture* of *Parts*: As when the *Spirit of Nitre*, mingled with detonated *Nitre* reſolved *per deliquium*, is turned into *Saltpeter*. Or, as when the *Spirit of Salt* being beaten with the *VVhite of an Egg*, doth communicate to it hardneſs, which it had not before.

V. *The Sea-water changeth its Colour by Agitation only.*

When the *Sea* is toſt and beaten with *VVinds*, it changeth its *Colour*, and what was a *Seagreen Colour* before, does now appear *VVhite*; as the ſame is Elegantly deſcribed by LUCRETIUS.

As in the Sea when the mad Ocean Raves,
And white Curles riſe upon the foaming VVaves.

Now who can be imagin'd so weak in his Intellectuals, as to attribute this change to any supervening *Quality*? For what Agent should effect this alteration? Or by what means could a real Entity be diffused through such a vast conflux of *VVater*? The *Sea* therefore becomes *white* by being turned into *froth*, that is, by the variation of its parts in their *Magnitude*, *Situation* and *Figure*, and rising into little *Bubbles*; whence the reflected light being conveyed to our Eye, represents a *white* Colour.

VI. *Great changes are produced in Bodies, only from the alteration of the Disposition of the parts.*

Thus, if *Mercury Sublimate* be put into hot *water*, and a few *drops* of *Spirit* of *Urine* dropt into it, and then filtrated, it becomes white like *Milk*. Thus *Red Lead* and *Coral*, by the infusion of *Oil of Tartar*, acquire a *white Colour*. Thus *Gold* being mixed with *Silver*, if afterwards it be separated by *Aqua Fortis*, a black *Powder* falls to the bottom, its first *Colour* being lost. Of which change no other cause can be assigned, than the *Figure*, *Texture* and *Order*, &c. of the Parts. For as LUCRETIUS expresseth it,

——*In Bodies so,*
As their Seeds, Figure, Order, Motion do,
The things themselves must change and vary too.

VII. *How water after various concoctions, changeth its former qualities.*

Put *water* into a strong *Pot* or *Vessel*, and having luted its Cover to it, and let it stand for some time upon *Burning Coals*, then remove it, and let it grow cold; then set it to *boil* again as before; and you'l find that by the repeating of these alterations several times, the *Colour*, *Taste* and *Smell* of the *water* will be changed.

This change in the water proceeds from nothing else, but the new *Order*, *Figure*, *Position*, &c. of its parts. For the force of the *Fire* separating the *particles* of the *Liquor*, makes them to acquire another position than they had before, by which means different qualities are induced into the *water*, and they made to affect our *senses* in a different manner from that they did before.

VIII. *Various Bodies arise from other Bodies, only by the figuration and position of the parts.*

How many sorts of *Plants* do we see grow out of *water* only, into which they shoot their *Roots*, and attracting it for their *nourishment*, do encrease in *weight*, grow up, and spread their *Branches*. And indeed it is a matter of wonder to see hot and *Caustick Plants*, such as *Crowfoot* is, growing and encreasing in, and from the *water* alone; neither can this change be assigned to any thing else, but the meer change of the *Figure* and contexture of the *Parts*. Thus from *churn'd Milk*, without any other accession of a new form, but by a pure transposition of *Parts*, *Butter* and *Buttermilk* are produced. Thus *Glass* is made of *Sand* and *Salt*, and *Roman Vitriol* of *Salt* and *Copper*; for as *Sand* gives *Glass* its firmness, so *Copper* or *Iron* afford the same to *Vitriol*.

IX. *Whence it is that Oysters have some part of them Red in the Summer.*

And for the same reason it is that Oysters, in the hottest *Months* of *Summer*, have the appearance of *Blood* in them; which Colour towards the approach of *VVinter* vanisheth, because then for want of *heat*, the *Oysters* cannot concoct the *Alimental Juice* to that high degree, as to produce *Blood*. And suitably to this *Physicians* tell us, that the *Redness* of the *Blood* proceeds from the acidity of the *Vital Saline Spirit*; much in the same manner, as *Juleps* by the instillation of a few *drops* of *Spirit* of *Vitriol*, acquire a *Red Colour*.

X. *Oyl of Tartar dropt into an Infusion of Sena-leaves, changeth the colour of it.*

If you drop a few drops of *Oyl* of *Tartar* into an infusion of *Sena-leaves* in *warm water*, the *water* will presently turn Red, and become of a *purple Colour*, tho' there be no such *Colour*, either in the *VVater*, *Leaves*, or *Oyl* of *Tartar*.

The Cause of which *Redness* is, for that the *Oyl* of *Tartar*, piercing into the *substance* of the *Sena*, doth so agitate and separate the parts thereof that it makes way for the most minute *particles* of the *water*, to enter the *Pores* of the *Sena*; and changing their *Texture*, make the Beams reflecting from them to exhibit to our *Eye* a *Red Colour*. And that this *Redness* is by this means produced, may be plainly evinced, because another *Oyl*, for instance, that of *Vitriol*, being infused in the said *water*, will not not produce the same effect; because it wants the power to penetrate the substance of the *Sena*, and separate its parts so, as to make way for the *Particles* of the *water* to enter.

XI. *Why two cold Bodies mingled together do sometimes produce heat.*

And the same may be applied to other *Qualities*, as *Heat*, &c. for our *Touch* assures us, that there is an extream *heat*, in *Stygian waters*, or *Corrosive Chymical Spirits* when *Metals* are dissolved in them. And in the *Spirit* of *Nitre*, poured upon the *butter* of *Antimony*, or the *filings* of *Lead*; when yet the said *Corrosive Spirits* as well as *Metals*, are both cold.

XII. *An Apple thrown against a Wall, doth acquire new qualities in that part where it hath been bruised.*

An *Apple* when dasht against another Apple, or when bruised by falling down to the Ground, or being thrown against a Wall, that part of the Apple which is bruised will be found to differ from the rest in *Smell*, *Taste*, and other *Qualities*; and this change is so great, as that it seems to be quite of another nature, than the other part of the *Apple*.

Which change proceeds only from the Transposition of its *Parts*, for no new thing is superadded to it by its bruise, but only the parts of the *Apple* are altered from the Position they had before. So likewise we see what a great change is produced in *VVine*, when it is changed into *Vinegar*; of which notwithstanding no other cause can be assigned, but a slight exhalation of some of its minute parts, or rather the change of their *Configuration*, by being shaped into little pointed *Swords*. And as by the exhalation of some *parts* this change is caused in *VVine*, so no less an Alteration of things is often produced, by an accession of new parts.

Thus an *Apple* or *Pear*, by being rolled hard upon a Table, doth grow soft, and of a sweet Taste, by a gentle distribution of the *Spirits* into all the parts of it, as the *Chymists* express it, the unequal Distribution whereof is the cause of a *harsh* and *sour Taste* in *Fruit*: For hard Rolling is a mean between *Concoction* and simple *Maturation*. But of this we shall treat more largely in the *Part concerning Plants*.

CHAP. II.

Of Heat.

I. *Why boiling water riseth up to the very brim of the Vessel, when before it reached only half way.*

WAter, which when *cold* is without motion in a *Pot* or *Kettle*, when it is hung over a *Fire* and *boils*, riseth up to the *brim* of it, when as before it scarcely filled one half of it.

The

The Reaſon is becauſe the *heat* of the *Fire* doth put the parts of the *Water* into *Motion*, and ſeparate them from each other, and is the cauſe why by reaſon of the admiſſion of *Air*, or ſome other inſenſible matter, they can no longer be contained within the ſame bounds as they were before, but require a greater ſpace for them to diſplay themſelves in. For it is common to all *Bodies* that are rarefied, to encreaſe in bulk by the reception of the *ſubtil matter* into their *pores*; and more eſpecially where the *Rarefaction* is cauſed by ſome conſiderable *Heat*, which puts the parts into Motion, and ſeparates them from each other.

II. *Why the heat of the Sun is commonly vivifying and vegitative, and that of the Fire deſtructive.*

The *Heat* of the *Sun* promotes the vegetation and vivification of *things*; whereas the *heat* of the *Fire* is rather deſtructive, and generates nothing by its activity.

The Reaſon whereof is, becauſe the *heat* of the *Sun* is moderate, and becauſe of its diſtance and perpetual circling about the *Earth* very gradually diſpenſt. Whereas the *heat* of *Fire*, becauſe it cannot reach far, and before it can produce any conſiderable effect, muſt approach nearer to *Bodies*, than is for their preſervation, doth preſently vaniſh, and either through the ignorance, or impatience of *men*, cannot be kept in that *temperature* which is neceſſary to the *vegetation* of *things*. But if ſo be, it can by the Art and Induſtry of *Men* be reduc'd to a due Temperature, then nothing will hinder but that *Eggs* may be *hatched* by it, *Plants* produced, *Inſects* generated, and all *living things* cheriſhed by the warmth thereof.

III. *A thing that is Lukewarm only, ſeems hot when touched with a cold Hand.*

A *Lukewarm Body*, touched with a *hot Hand*, ſeems *cold* to us; and *hot* when we touch it with a *cold Hand*.

Which different *Senſe* doth not proceed from the thing that is *Lukewarm*, but from the *Hands* that touch it; for tho' the ſame force be in the *Lukewarm Body* to agitate both hands; yet becauſe the commotion of the parts of the *hot Hand*, doth exceed the Agitation that is in the parts of the *Lukewarm Body*, it makes the *heat* of the *Lukewarm Body* to appear or feel *cold*. For the Agitation of the *Particles* of any *Body* conſidered in themſelves, is not called *heat*, but only ſo far as it affects our *Senſe* of *Feeling*.

IV. *Why the ſame Baths are ſometimes judged hot, and at other times cold.*

So they who enter *Baths* diſtinguiſht by different degrees of *heat*, having continued for ſome time in thoſe that are *Lukewarm*, before they enter thoſe that are *more hot*, find that that *water* which at firſt was ſo *hot*, that they could ſcarcely bear it, doth now ſeem *cold* to them; becauſe their *Body* being thorough *hot* by the heat of the *Baths*, can no longer be affected by a *weaker heat*. Neither is it to be queſtioned, but what ſeems to be *hot* with *Scythians*, who live in a very *cold Air*, would be eſteemed cold to *Æthiopians*, that live in a very *hot Climate*.

V. *Cellars and Caves under ground, are not hot in* Winter-*time.*

Wherefore 'tis a *miſtake* in ſome, who conceive that *ſubterraneous places*, as *Cellars*, and the like, are *warmer* in *Winter*, than in *Summer*: ſeeing that this difference of *heat* proceeds only from our Body, which is differently affected in *Winter*, from what it is in *Summer*: And we do not mind that the ſame thing may appear cold to one that is *hot*, and on the contrary, *hot* to one that is *cold*. For if it be ſo indeed, that *Subterraneous Caverns* are hot in *Winter*, whence is it that the *Oyl* that is kept in them congeals, which it doth not in *Summer*, when yet they appear to be *cold*? *Subterraneous places* therefore are judged to be *hot* in *cold weather*, becauſe our *Bodies* are *cold* when we enter into them; and in *Summer*, *cold*, becauſe at that time our *Body* is *hot*.

VI. *Why Gold burns more violently than Fire.*

A *Molten Metal*, and eſpecially *Gold*, burns more ſtrongly than the *Flame* whereby it is agitated, and whence it is put into its *heat*.

This proceeds from the compactneſs and cloſeneſs of the parts of *Gold*, which being fat and thick, cannot be dilated, or very little, which is the reaſon that it both *burns* more vehemently, and retains its *heat* longer. For the *particles* of the *Fire*, are as it were ſhut up in the *Gold*, without being able to diſentangle themſelves. Whence it is that a *Man* cannot touch *Gold* in *fuſion*, with his *Hand*, but that the *Skin* of it will be ſhrivel'd up and burnt immediately. And on the contrary, *Iron* produceth a greater *heat* in *Aqua-fortis*, than *Gold* it ſelf doth, becauſe this *Liquor* enters the ſofter parts of *Gold* with leſs force and violence. For the ſame Reaſon *boyling Oyl* burns more violently than *Water*, becauſe of the Connexion of its fat and unctuous *parts*, which do more tenaciouſly keep the *particles* of *Fire* encloſed, and ſuffer them not to get away.

VII. *Why a Nail does not grow hot by the ſtroaks of a Hammer, till after it be driven home.*

A *Nail* ſtruck with a *Hammer*, and driven into the hardeſt *wood*, doth not feel *hot*, whilſt it is entring the *wood*, but is only perceived to grow *hot*, by thoſe ſtrokes of the *Hammer* that light upon it, after that it is driven home.

The Reaſon hereof is evident from the Nature of *Heat*, which doth not conſiſt in the direct motion of *Bodies*, but only in the Agitation of the *Inſenſible Parts*. So that it is apparent, that the *Nail* cannot be *heated*, as long as the *whole* of it is in motion, and is entring the *wood*; but when it is driven home, the Stroaks that afterwards light upon it, put the inſenſible *particles* of it in motion, wherein the nature of heat conſiſts. But the contrary happens when *wood* is ſawed with a *Saw*, or bored with an *Auger*, becauſe then the *Saw* and the *Auger* grow hot, and not the *Wood*, becauſe in this caſe the inſenſible parts of the *Saw* and *Auger*, are moved and not thoſe of the *wood*.

VIII. *Why the Iron that is Filed grows hot, and not the File it ſelf.*

When a piece of *Iron* is filed, it is obſerved that it will grow *hot*, but the *File* remain *cold*.

The Reaſon is, becauſe the *File* excites a great *commotion* in the parts of the *Iron*, which produces *heat*. And tho' the *parts* of the *File* do ſuffer the ſame force, as the *parts* of the *Iron*, yet becauſe they are much longer than it, they do not with the very ſame *Teeth* touch the ſame part of the *Iron* twice; but there is always ſome ſpace of time between the gratings of the parts of the *File*, during which, that part of the *File*, that began to be heated, loſeth its heat again.

IX. *Why the Axeltree grows hot, and not the Iron Plate that is on the Wheel. And why the Bullet diſcharged from a great Gun is not heated.*

So likewiſe the *Axeltree* of a *Coach* or *Cart* grows hot, and not the *Iron-plate* that goes round the *Wheel*, becauſe tho' it deſcribes greater lines, yet are not its parts agitated amongſt themſelves, like that part of the *Wheel*, which rubs continually againſt the *Axeltree*. Becauſe the Eſſence of *heat* doth not conſiſt in the ſwiftneſs of the motion, wherewith any *Body* is moved, but in the violent and various agitation of the inſenſible parts of

of *Bodies*. Thus the *Bullet* discharged from a Great *Gun*, and most swiftly moved, doth not burn the *wood* which it penetrates, nor the *Bullet* discharged from a *Cross-bow*, doth not *fire* a dry piece of *Linnen* that it is shot through; because tho' both these *Bullets* be most swiftly moved, yet are not their parts put into any agitation.

X. *Why the Breath we breathe forth with our open Mouths is warm, whereas that which we put forth with more force through our almost shut Mouth, is cold.*

The *Breath* we *breathe* with open *Mouth* into our *Hand* doth heat it, but if we blow it forth with vehemency through our *Mouth* almost shut, it is cold, and cools, suppose hot *Pottage*, or any thing else.

Our *Breath* causeth *heat*, when it is breathed forth *gently*, that is, when it consists of parts variously agitated, and when it unequally lights against the *hand*. For the *heat* of *Bodies* is nothig else but the *various determination of their insensible parts*, whereby they are moved this way and that way. But the *Breath* we blow from our *Mouths*, drives out the *heat* from any *Liquor*; because it is swift and determined to one part only: For by this means the most subtil parts of the *Liquor*, cannot separately continue their own proper motions, because they are all driven and determined by the *blast* of our *breath* to one part; as the motion of all the parts of a *River* is determined one way.

XI. *Why Quicklime, and some other Artificial Stones grow hot, when sprinkled with water.*

Quicklime grows *hot* when *water* is cast upon it, to that degree, that it burns more violently than a *Flame*.

The *Reason* is, because the *Pores* of the *Limestone* which before only were open to the passage of the *Globuli* of the Second *Element*, have been more dilated by the *Fire*; so as that afterwards they were free to admit the *particles* of *water* also, but yet only such of them as were surrounded with the matter of the first *Element*, which rushing against the hard *Particles* of the *Quicklime*, do shake and separate them, especially if there be any store of them, and they do from divers parts, rush against one and the same same part of the *Quicklime*. And in like manner we see that an *Artificial Stone made of Pitch, Tarr, Tartar*, Brimstone, *Saltpeter, Sarcocolla*, and *Oyl* of *Peter*, equal parts, and as much *Quicklime* as all of them, mixed with the *Yolks* of *Eggs*, and kept for some days buried in *Horse-dung*, if it be sprinkled with *fresh water* doth break forth into a flame.

XII. *Why the heat of Quicklime exceeds the heat of a Flame of Fire.*

The *heat* caused in *Quicklime*, by the asperson of *water*, is more violent than the *flame* that proceeds from *Fire*, because the *Quicklime* consists of *branchy particles*, which when they are separated from them the matter of the first *Element*, which surround the *particles* of *water*, do violently strike the hand, piercing and rending the *Skin* like so many *Needles*. And for the same reason a *Coal*, whose parts are intangled with long and various *branchy parts*, produce a greater heat than *Flame* doth. Thus *melted Metal*, and more especially *Gold*, burns more strongly than *Oyl*, and retains its *heat* much longer; because *Gold* consists of a more close and compact *unctuous matter*, and therefore is less subject to be dilated, and to let the *particles* of *Fire* it hath received to fly from it.

XIII. *Why a Red hot Iron is made use of for the cutting of Glass*

Glass is commonly cut with the *Edge* of a *red hot Iron*, or with a *Packthread* dipt in Brimstone.

The Reason whereof is, as was before said, that the parts of the *Glass* being agitated by the *heat*, require more room, and therefore drive the neighbouring *Bodies* from them. For it is impossible that the *parts* which are *heated*, should move swiftly and circularly, without taking up more space. This is evident, as in all other *Bodies*, so even in the most compact *Bodies* of *Metals*, which do somewhat swell, and become distended by *heat*.

XIV. *How Heat comes to be produced by two cold Liquors mingled together.*

Liquors, that of themselves are *cold*, when pour'd together produce a great *heat*. Thus *Spirit* of *Vitriol* added to *Oyl* of *Turpentine*, grows very *hot*. It hath been also observed that *Spirit* of *Wine*, by degrees added to *Aqua-fortis*, or *Spirit* of *Nitre*, doth cause a great and lasting *heat*.

Which *Heat* is caused from the diversity of the *parts* whereof the *Liquors* do consist; as being of such *Figures*, as that upon their mixture, they can the better join together, than when they are separate and by themselves, and that in this closing together, they swim upon the *matter* of the *First Element*, at least at the time that they are perceived to *boil* or efferveşce. Which may be confirmed from hence, that after their ebullition is ceased, it is evident that many of them are grown together, constituting several hard *Bodies*. In the same manner, *Oyl* of *Vitriol*, when *cold water* is pour'd upon it, grows hot; and *Aqua-fortis* into which *Salt Armoniack* hath been infused, doth contract a *heat*, by casting into it some bits of Brimstone. Thus the *Spirit* of *Salt Armoniack* and *Tartar*, and the *Filings* of *Lead*, or the *Oyl* of *Vitriol*, and the *Filings* of *Steel* joined together are productive of *heat*. And which may seem more wonderful, *Ice* it self being put into the *Oyl* of *Vitriol*, causeth so great a *heat*, as to send forth *Smoak*. And so *Fruits* also, as *Cherries*, when put into *Spirit* of *Nitre*, produce a considerable *heat*.

XV. *The mingling of Brimstone with Steel, produceth Heat.*

We must not here omit a notable experiment, which is, that if you mix half a pound of *Flower* of Brimstone, with the same weight of *Filings* of *Steel*, and put this mixture into *cold water*, stirring it now and then, it will cause so great a *heat*, that the vessel will be too hot to be touched. Thus *Quicksilver* prepared after a peculiar manner, and amalgamated with *Gold*, doth give such a *heat*, that it cannot be endured.

XVI. *The Stone* Magnesia *dissolved in Oyl of Vitriol, produceth heat.*

In like manner the *Stone MAGNESIA*, which in hardness resembles the *Loadstone*, when put into the *Oyl* of *Vitriol*, stirs up a great *heat*, which is encreased by repeated affusions of *water*, and like *Iron* communicates a Red *Colour* to the *Aqua-fortis*, sends forth a sharp and stinging fume; and when some of it is put upon *Molten Glass*, presently the *Glass* swells, which is common to it with *Copper* and *Iron*. Thus if you cast a *little Filings of Brass* into a great *Bottle*, in which there is only a small quantity of *Aqua-fortis*, there follows such an efferveşcence, that the *Bottle* seems to be full, and produceth so great a *heat*, that the *Bottle* cannot be touched.

XVII. *Two hot Bodies mixt together, produceth sometimes a third, that is cold.*

Sometimes two *hot Bodies* mingled together, produce a third of a different Nature: For if you pour the *Spirit* of *Nitre*, which is very hot and piercing, upon *Lixivous Salt*, the product of this conjunction will be *Saltpeter*, which cools rather, than is productive of *heat*.

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The Cauſe whereof is, becauſe the *particles* of *Nitre* and *Salt* become ſo intangled together, as that they loſe their ſharp points, whereby before they were uſed to diſſolve *Bodies*. For the *Bodies* of the *Nitrous Spirit*, which before were volatile, and were eaſily ſent away into the *Air*, being now kept down by the fixt *Salt*, can no longer fly away. And therefore it is no wonder that the *Spirit* of *Nitre* loſeth the power of *heating* which it had before, and ceaſeth to be Corroſive.

XVIII. *How Snow comes to be condenſed by heat.* Notwithſtanding that, it is the property of *Heat* to rarefie *Bodies*, and by looſning of their parts, to make them take up more room: Yet, for all that, we find that it doth condenſe *Snow* and *Clouds*. The Reaſon whereof is, becauſe the *filaments* of the *particles* of *Ice*, whereof *Snow* doth conſiſt, being more thin and ſlender than the middle part of them, they are conſequently upon the approach of *Heat*, more eaſily diſſolved, and bending themſelves this and that way, becauſe of the agitation of the *ſubtil matter* that ſurrounds them, they, embrace the neighbouring *particles* of *Ice*, without quitting thoſe they were intangled with before; and by this means conſtitute a more compact *ſubſtance* than they did before.

XIX. *The ſame effect is produced by heat in the Clouds.* This effect is ſtill more clearly diſcoverable in the *Clouds*; for ſince the *particles* of *Ice*, whereof they conſiſt, are at a greater diſtance from each other, and leave greater *Intervals* between them, they cannot approach to their neighbouring *particles*, but that at the ſame time they muſt be ſeparated from ſome other; and therefore when they are bent, muſt needs take up leſs room, and conſequently conſtitute a more cloſe and compact *Body*.

XX. *Heat turns Lime and Aſhes into Glaſs.* *Lime* and *Aſhes*, by the *heat* of the *Fire*, are turned into *Glaſs*: For the *Cryſtal Glaſſes* of *Venice* are made of *Stones* which are found near the River *Ticinus*, and brought from *Pavia*, with an equal quantity of the *Aſhes* of an *Herb*, which the *Arabians* call *Kall*, and which grows in the Deſert between *Alexandria* and *Roſetta*.

The Effect of reducing theſe to *Glaſs*, is never produced, but by a long continued *Fire*, and that in the higheſt degree: For ſeeing that the *particles* of *Lime* and *Aſhes* are thick and irregular they cannot ſo lie upon one another, as to ſtick or cleave together. Wherefore a *ſtrong Fire* muſt be employed, to exerciſe its activity upon them; for then, whilſt the thinner *particles* of the Third *Element*, together with the *Globuli* of the Second *Element*, are laid hold of, by the matter of the Firſt *Element*, and proceed to move moſt ſwiftly about them, their Corners are by little and little worn off, and their *ſurfaces* being made more ſmooth, and ſome of them bended, flowing over one another, they no longer touch each other now in ſome points, but are joyned with their whole *ſurfaces*, and ſo ſticking together, conſtitute that *Body* which we call *Glaſs*.

CHAP. III.

Of Cold.

I. *No Body is altogether deſtitute of Heat.* NO Body, how *cold* ſoever it may ſeem to the Touch, is wholly devoid of *Heat*. For *water*, which to our ſenſe is moſt cold, is proved not to be deſtitute of all *heat*, becauſe of the *Vapours* and *Steams* which we ſee do ariſe from *Rivers* and *Pools*, even in the *Winter* time, and in the Night time.

The Reaſon is, becauſe *Cold* is nothing elſe but the *want* of *Heat*; and as *Darkneſs* is the privation of *Light*, which is the companion of *Heat*, or the effect of it; ſo *Cold* ſeems to be nothing elſe but a privation of the ſaid *Heat*; and therefore that which we call *Cold*, is nothing elſe but a more remiſs degree of *Heat*.

II. *Why a Hand benumb'd with cold, when held to the Fire, is ſeized with extream pain.* It happens ſometimes in very *Cold Weather*, that Mens *Hands*, and other parts of their *Body* grow *numb'd*; which when they come near the *Fire*, are ſeized with very ſharp pricking and ſhooting pains.

The Reaſon whereof is, becauſe the *particles* of *Fire*, being in continual motion, do with violence run a-tilt upon the Nerves of the Hands, or other Members that are benumb'd with *cold*, and wound them as it were with ſo many pointed *Lances*. Which *Vellication* of the *Parts* cannot be without cauſing great *Pain*. Wherefore to reſtore a *Hand* benumb'd with *cold*, we muſt not preſently expoſe it to the *Fire*; but firſt gently rub it, and endeavour to bend and move the Joints, that by this means the chaced *blood* may be recalled, and the parts that were *aſleep* or *benumb'd*, may again come to themſelves. Wherefore in *Swedeland*, *Denmark*, and other cold *Countries*, when any one chanceth to be thus benumb'd with *cold*, or in danger to be ſeized with a Gangrene, they preſently put the part into *cold water*, or *Snow*, for by this means the *pores* that were ſhut up by the *cold*, are opened by degrees, and make way for the *baniſht vital Spirits* to return to them again, whereby the parts are ſoon after recovered to their former ſtate.

III. *What happened to K. James I. in Denmark.* Thus BARCLAY tells us, that when King JAMES I. was in *Denmark*, and that by the *cold*, the end of his *Noſe*, and the *Lappets* of his *Ears* were become without all *feeling*, and almoſt mortified, he by the advice of the *Inhabitants*, applied *Snow* to them, to preſerve them from a *Grangrene*.

The Reaſon of this cure of *frozen* and *benumb'd parts* is, becauſe the *groſſeſt matter of the Second Element*, which got out by their *pores*, when the cold began to ſhut them up, cannot reenter again, in order to reſtore to thoſe parts their former ſoftneſs, without deſtroying their connexion, which might cauſe a mortification or *Gangrene*, which is avoided by rubbing the parts with *Snow*, becauſe the *Snow* contains nothing in its *pores* beſides the moſt ſubtil matter of the Second *Element*, which is very proper and fit to open by degrees the *pores* of the *congealed parts*, till they be wide enough to let the more groſs *matter* of the Second *Element* paſs through them alſo.

V. *How frozen Apples may be restored to their former state.* Neither can any other Reason be given, why *frozen Apples* being put into *cold water*, are restored to their former condition, than that the *cold water* doth gently dissolve the congealed *Humour* in the *Apples*, and consequently causeth that effect of the *Cold* to cease.

V. *Why the Air is so exceeding clear in Extream cold weather.* During the most violent *Cold* of *Winter*, the Air is most thin and serene; but when the *Cold* is more remiss and moderate, it is generally *Misty*.

The Reason whereof is, *First*, because extream *Cold* doth more condense the thick *Vapours* of the *Air*, and by this means makes them to fall down, and consequently leave the *Air* more clear and serene than it was before. *Secondly*, Because extream *Cold* shuts up the *pores* of the *Earth*, by which means the *Vapours* are hindred from exhaling thence, and darkning the *Air*. Whereas *moderate Cold* produces a *cloudy* and *misty Air*; because the weak *Heat* which is joyned with that *Cold*, raises up *Vapours* from the *Earth*, which it is not strong enough to discuss or dissipate.

VI. *Marble in the Heat of Summer retains its Coldness.* Some *Bodies* never quit their *Coldness*, as *Marble*, and such like, which in the *hottest season* of the year feel very *cold*. So likewise *Ice* retains its hardness in the *Summer*, and is as *cold* then as in the *Winter*.

These familiar Instances make out, that *Cold* is nothing else than *Rest* or privation of *motion*. For the parts of *Cold Bodies* do cleave and stick fast together, so as to constitute a most close and compact Compound. But how doth it come to pass, that *Marble*, *Ice*, and other *Bodies* of like Nature, do preserve their *Coldness*, at all *Seasons*, in the same intense degree?

I Answer, That this proceeds from the *Heavenly Globuli*, which penetrate their *pores*; for the largest of them being endued with a stronger force of moving, do produce *Heat*: Whereas the lesser of them, which are inferiour in Force to others, do communicate *Cold* to *Bodies*, as will appear from the Experiment. *Marble* therefore is thus *Cold*, because the *pores* thereof are so strait and narrow, that they can only admit the very least *particles* of the most *subtil Body*, excluding the greater that cause *motion*. And forasmuch as *Water* does never *freeze*, except when the Matter which runs between its parts is more subtil than ordinary, it so happens that the *pores* of *Ice*, which are then formed according to the bigness of these *particles* of the most *subtil matter*, by this means become so narrow, that they shut out those *particles* that are never so little greater. And this is the reason why *Ice* continues to be most intensly *cold* in the midst of the greatest *heats* of *Summer*. This also may be perceived by the Dissolution of it; for *Ice* doth not melt like *Wax*, whose flexible *particles*, give way to the Agitation of the *Fire*, and by the force thereof are separated: For the narrowness of its *pores* hinders the *Heat* from entring to its inward *parts*, save only as the outsides of it melt away, and are broken by the force of it.

VII. *How water by means of Salt, may be turned into Ice.* Put some *Water* into a *Glass*, and lay *Snow* mixt with *Salt* round about it, so as to touch the sides of the *Glass*; and as soon as the *Snow* and *Salt* begin to dissolve, the *water* will be turned to *Ice*, not only in the *winter* time, but at any other time of the year.

The Reason of this *Experiment* is, because the greater *Globuli* of the *second Element*, which by their agitation are the cause of the *waters* fluidity, being of more force than those which run betwixt the parts of the *Snow*, and finding a more convenient place for themselves to move in, the stiffer and smoother *particles* of the *Salt* and *Snow* do necessarily tend that way: And forasmuch as Nature doth not admit a *penetration* of *Bodies*, and that all *motion* is performed by means of a *Circle*, the lesser *Heavenly Globuli* contained in the *Rain* and *Snow*, upon the approach of the greater, strive to get out, and to return to the places they have left, through the *pores* of the *Glass*. But because these *Globuli* are not sufficient to continue the motion of the *water*, consequently thereupon it becomes congealed, and acquires the coldness and hardness of *Ice*. And on the contrary, the *Snow* mixed with the *Salt*, dissolves and runs to Liquor, because it is agitated by the greater *Globuli*, which before, by their motion, kept the *water* liquid.

VIII. *Whence it is that the Spirit of Wine doth cool.* And probably it is for the same Reason, that *Spirit* of *Wine*, which is hot of its own Nature, doth cure Inflammations and the *Squinzy*; and also cools and heals the part that is scorched with *Gunpowder*; *viz.* because the *Spirit of Wine* hath its *pores* so disposed, that being applied to the enflamed part, it only admits the lesser *Globuli* of the *second Element*, which by their more remiss and soft agitation of the parts, do asswage the pain.

IX. *Diseases cured by likeness and sympathy.* Thus the Inflammation of the *Emrods* are cured with a *Toasted-Onion*, or fulminating *Gold* mixt with *Brimstone*. For the Juice of the *Onion* being very sharp, with a mixture of Sowrness, as *Salt Armoniack* and *Tartar* also are, which enter the composition of fulminating *Gold*, draw forth from the part affected, the *Humour* that is analagous with them, and mixt with it. It is a thing also owned by *Physicians*, that *Diseases* of *Men* may be communicated to *Animals*, by reason of the *analogy* of parts. Thus Mr. BOYLE tells us of a *Potters* Son, that was cured of the *Kings-Evil* by a *Dogs* often licking of it; the Disease having been by this means transplanted in the *Dog*.

X. *Cold is very hurtful to Plants.* *Cold* doth great harm to *Plants*, and if we may speak with the Ancients, doth *scorch and burn them up like Fire*.

This indeed is commonly ascribed to *Cold*; but if we diligently weigh the matter, we shall find that according to Truth it can be no more than the remote cause of this effect; because it rather proceeds from the *Heat* which follows upon the breaking of the *Frost*. For seeing that the *heat* cannot enter the *pores* of the *Plants* that are shut up by *frost*; neither can it restore to their Inward *parts* that degree of *softness*, which they had before their congelation; since the said *Frost* hath spoiled the connexion and situation of the other parts, and therefore there cannot but follow an entire change of the whole, that is made up of these parts.

XI. *Why sometimes the contrary happens.* But yet sometimes it happens, that some certain *parts* of *Plants*, do without hurt endure *Cold*, as when the *pores* of *Plants* are shut up by *Cold* before that they begin to *bud*; for before that time they do not so much abound with that watry *Juice*, and their *pores* however narrowed by *Cold*, are

are ſtill open enough to give entrance to the *ſubtil matter* that may agitate the parts. For it is not neceſſary that their contexture ſhould be deſtroyed by it, which are the firſt that bear the onſet, before the Inward parts be ſet upon.

XII. *Why a cold Body, ſuch as Marble, cools the Air that is near it.*

The *Air* that ſurrounds a cold *Body*, as *Marble*, is colder than that which is farther from it.

The reaſon whereof is, becauſe ſcarce any but the moſt *ſubtil matter* hovers about *Marble*, either that which is about to enter the *pores* of it, or which flows out from it: And becauſe this *ſubtil matter*, becauſe of the tenuity of its parts, is not able to move the thicker *particles* of the *Air*, that might cauſe the *Senſe* of *Heat* in us; for this Cauſe it is that the circumambient *Air* is perceived to be *cold*.

XIII. *What is the Reaſon of the cold Air that is about Fountains.*

And it ſeems to be for the ſame Cauſe, that a cool *Air* is perceived about thoſe *Fountains*, whence the *water* leaps up with great force; *viz.* becauſe the thicker parts of the *Air*, which ſerve to excite *Heat*, are ſeized, and carried away by the *water* guſhing forth, ſo that nothing but the *Æthereal matter* is left there.

XIV. *Why Cold makes the water in a Weather-Glaſs to mount upwards.*

When *Water*, or *Spirit of Wine*, tinged with a Red or other *Colour*, is put into a *weather Glaſs*; this *Liquor* doth of it ſelf riſe or fall, according to the *coldneſs* or *heat* of the Weather.

The *Peripateticks* aſſign the Cauſe of this Effect to be the condenſation of the *Air*, which is in the upper part of the *Pipe*; and that thereupon the *water* is forced to move upwards, that it may fill up the *Empty ſpace* which the *Air* hath quitted. But what, ſhall we conclude then, that an inſenſible *Body*, ſuch as the *water* is, can be ſo ſolicitouſly concern'd for the good of the *Univerſe*, that leſt Nature ſhould ſuffer a *Vacuum*, it rather mounts upwards, in downright contradiction to its own ponderoſity? Wherefore they ſpeak with a great deal more of probability, who ſay, that in *Weather Glaſſes* the *Air* is condenſed, and the *water* driven upwards by the incumbent weight of the *Air*. For in theſe *Glaſſes* the *Elaſtick virtue* of the ſhut up *Air* is very much leſſened, by which means the Circumambient *Air* does more preſs the *Water*, than the *Spring* of the pent up *Air* can bear.

XV. *The Froſt rarefies water.*

Water is dilated by *Froſt*, and takes up more ſpace than it did before, whereof we have an evident inſtance in a *Glaſs-veſſel* with a long *Neck*, for when we expoſe ſuch a Veſſel fill'd with *warm Water* to the *Winter cold*, the *Water* will ſenſibly ſink down or decreaſe, until it be come to a certain degree of *Coldneſs*: And not long after, it will begin to ſwell again and mount upwards till at laſt being bound to its good behaviour by *Froſt*, it ſtands ſtill and remains immoveable.

The cauſe of this *Rarefaction* is, becauſe the *particles* of the *Liquor* that are ſhut up in the *Glaſs*, before they begin to be *Frozen* by *Cold*, grow *Stiff*, by reaſon of the leſſened *Motion* of the *ſubtil matter*, and take up crooked *Figures*; and therefore cannot cleave ſo cloſely together, as when they were ſoft and pliable. And hence it is, that being vehemently ſhaken by the *ſubtil matter*, they cannot reduce themſelves to ſo narrow a room as they had before, but require a larger wherein to dilate themſelves.

It is worth our obſerving, that *Frozen Water* by reaſon of its *Dilatation* does commonly break the *Glaſs-vials* wherein it is contained, eſpecially if the upper part be *Frozen* firſt: Becauſe the *Water* being dilated by *Froſt*, ſticks faſt to the ſides of the *Glaſs*; ſo that when the *Water* that is under it comes to be congeled likewiſe, it breaks the *Glaſs*, becauſe it finds no room wherein to expand it ſelf. But we find a quite contrary effect, when *Water* is *Frozen* in the bottom of a *Veſſel*, firſt by *Snow* and *Salt* laid about it. For then the upper part of the *Water* doth by little and little mount higher, and by this means prevents the breaking of the *Glaſs*.

XVI. *Why water freezing in a Glaſs, does ſometimes break the Glaſs, and at other times not.*

Wherefore it is no wonder, if ſometimes great *Veſſels* of *Marble* are broken by the freezing of the *water* that is contained in them, which *CABÆUS* tells us he hath been an Eye-witneſs of: Nay, what is more, *Artificers* ſometimes find by Experience, that ſome of their *Copper Veſſels* have been broken for no other cauſe. It is alſo an Obſervation of the Noble and Ingenious Mr. BOYLE, that the ſpace of *Frozen water* hath been increaſed a ninth or tenth part more than it was before; for elſe, how could it be that *Iron Pipes*, ſuch as are made uſe of for great *Guns*, fill'd with *water*, and ſhut up with the greateſt care and induſtry, ſhould break by being expoſed to the cold *Air*? As hath been often experienced in *England*, and other parts of *Europe*.

XVII. *Why ſometimes very ſtrong Veſſels are broken by the freezing of the water that is contained in them.*

Neither muſt it ſeem any ſtrange thing to us, that the *ſubtil matter* ſhould not be able to bend the ſtiff *particles* of the *water*, when yet it hath force enough to move them; foraſmuch as a leſſer Force is required to move *Bodies*, than to bind them: For we can eaſily with our *Hand* thruſt a *Bar of Iron* out of its place, but find our ſelves altogether unable to bend it.

XVIII. *What the Reaſon is of the ſtiffneſs of the Particles of Ice.*

This will alſo inform us with the Reaſon, why the *Ground* that is *frozen* riſeth higher, and burſts into many ſlits, to the great damage of tender *Plants*, whoſe *Roots* are often pluckt up; except theſe Chinks in the *Ground* be cover'd either with *Snow*, or ſome ſeaſonable warm *Rain*. For the *Froſt* raiſeth and diſtends the *particles* of the *Earth* and *Water*, and ſo makes them take up more room, than if they continued in their Natural *figure*.

XIX. *Why the Ground that is frozen riſeth higher.*

As it is the property of *Cold* to *Rarefie* the *Water*, ſo it is endued with another quite oppoſite to this, which is that of condenſing almoſt all *hard Bodies*. For as *Heat* rarefies *Bodies*, by making their *parts* that are circularly moved, to remove ſomewhat farther from each other; ſo *Cold*, which is oppoſite to it, is the Cauſe why theſe *Bodies* are condenſed, by keeping their parts at Reſt, or by making them loſe the determination of their *Circular motion*. Thus we find by Experience, that the moſt hard and compact *Bodies*, ſuch as *Metals*, *Glaſs* and *Marble*, do ſenſibly contract themſelves in hard *Froſts*, and become more *brittle* than before, and upon a *Thaw* return to their former ſtate.

XX. *Cold alſo Condenſeth hard Bodies.*

It is alſo from the ſame Cauſe that *men*, who ſwim in *Cold water*, or otherwiſe affected with the Circumambient *cold Air*, are almoſt continually provoked to make *Water*; becauſe the Contraction, which is an effect of the *Cold*, is communicated to the *Bladder*, and ſo cauſeth the liſt

XXI. *Great Cold provokes frequent voiding of Urin.*

liſt to make *water*. And therefore if the *Hand* of one that is faſt *aſleep* be dipt in *Cold water*, it cauſeth him immediately to let go his *water*. And for the ſame Reaſon it is, that thoſe who come out of a *warm Bed*, as ſoon as their *Bodies* come to be expoſed to the *cold Air*, find themſelves to ſtand in need of *making water*: For as ſoon as the motion of the *particles* is allayed by *Cold*, and the parts thereby contracted, the ſame is alſo communicated to the *Bladder*, which thereupon endeavours to rid it ſelf of its burthen.

XXII. *How it comes to paſs, that Ice can be preſerved whole and entire all the Summer over.*

Ice may be ſo preſerved, as to retain its *hardneſs* all the *Summer* over, ſo as that it will ſcarcely *melt* when laid near the *Fire*.

The Reaſon hereof is, becauſe the *pores* of *Ice* are ſo narrow, that it can admit nothing, ſave only the *particles* of the moſt *ſubtil matter*, and conſequently by excluding all greater *particles*, hinders the *Heat* from entring to the Inward *parts*, ſave only as the melting of the Outward *parts* make way for it.

XXIII. *Whence cold Bodies have the power of changing Water into Ice.*

Cold Bodies, ſuch as the *Air*, often change the *water* they touch into *Ice*.

The Reaſon is, becauſe *cold Bodies*, by their Touch, do not only leſſen the *motion* of the inſenſible parts of the *water*; but alſo foraſmuch as they contain many *Icy particles*, that is, *ſmooth* and *ſtiff*, they make the greater *Globuli* to paſs out of the *water* into the *pores* of the *cold Bodies*; and on the other hand, cauſe the *little Globuli* to paſs out of the *cold Bodies* into the *water*. And foraſmuch as theſe *little Globuli*, becauſe of their remiſs degree of *motion* cannot preſerve the *water* in its fluidity, their *motion* by this means ceaſeth, and by this *Reſt* of their *parts* are changed into *Ice*.

XXIV. *Fruits and Stones too, are ſpoiled by Cold.*

Extream *Cold* is of that Malignity, that it is the Cauſe of the *Corruption of Bodies*, changing their *Colour*, and ſpoiling all their *Comlineſs* and *Beauty*. This we ſee not only in *Eggs* and *Fruits*, but alſo in *Wood* and *Stone*, which with *Froſt* are ſometimes made ſo brittle, as to be unfit to be uſed in the *Building* of *Houſes*.

Froſt cauſeth this *Putrefaction* in *Bodies*, by dilating the *watry parts* wherewith the *pores* of *Bodies* are fill'd; becauſe by this dilatation the *fibres* and other ſolid parts, are broken or diſtorted. For nothing elſe can be underſtood by *Corruption*, but the *Tranſpoſition of parts*, when thoſe which were joyned, are ſeparated, and enter upon new Combinations. Hence it hath been obſerv'd, that when the *Eyes* of *Animals* have been *frozen*, the *Cryſtalline Humour* hath become of a *white Colour*, whereas it was tranſparent before.

And from the ſame cauſe it is, that *Men* in *Ruſſia*, and other *cold Countries*, do loſe their *Noſe*, *Ears*, and othe parts of their *Body*, by the Rigour of the *Cold*, which mortifies and putrifies the parts, as before hath been ſaid.

XXV. *Cold ſometimes perverts the order of Parts.*

Such is the *Power* of *Cold*, that it ſometimes perverts the Order and Texture of the parts of *Bodies*. For to what elſe can we impute, that great *Beams of Timber* in very Cold *Countries*, are to that degree *frozen*, that except they be thawed with a moderate *Heat*, they ſlit to pieces, and are altogether uſeleſs for *Building*? Whence is it that *Marle*, laid upon the *Ground* to dung it, does never obtain its end more, than when it is *frozen* by extream *Cold*? For the *Moiſture* that was contained in its *pores* being by this means dilated, the Texture of its *parts* becomes diſſolved; ſo that whenever a good *Shower* falls; they are the more eaſily diſſolved and mingled with the *Earth*.

XXVI. *The Cold preſerves ſome Bodies from Putrefaction.*

And on the other hand, *Cold* preſerves ſome *Bodies* from *Putrefaction*; whereof the *Swallows* are an inconteſtable Proof, which being ſtiff with *Cold*, and in appearance no other than *dead*, are kept all the *Winter* over in many of the Pools of *Poland*, without the leaſt taint of Corruption.

The Reaſon of this is, becauſe *Cold*, whoſe Nature conſiſts in *Reſt*, doth reſtrain the *motion* of the *parts*, and conſequently hinders their ſeparation from each other: For the diſſolution of *parts* is the ready inlet of *Corruption*, foraſmuch as thereby the whole Texture of the *Body* is diſorder'd.

In like manner we find, that all manner of *Meats* and *Drinks*, are better preſerved in *Winter*, than in *Summer*; and that *Flowers* and *Fruits* are kept for a long time untainted in *Snow* and *Ice-Houſes*. Hence it is alſo, that *Dead Bodies* cover'd in the *Snow*, continue a long time without putrefying. In *Iſeland* they cuſtomarily expoſe their *Fiſh* and *Fleſh* to the *Air*, and when they are throughly hard and dry, preſerve them untainted a great while without any *Salt* at all added to them; becauſe the *Cold* keeps their parts at *Reſt*, and ſuffers them not to be ſeparated from each other.

CHAP. IV.

Of Heavineſs and Lightneſs.

I. *Two Bodies of unequal Bulk are moved with an equal motion, if they be Spherical.*

IF two *Bodies* of a *round Figure*, the one of *Lead*, the other of *Wood*, of the ſame or different bigneſs, ſhould be let fall from the ſame *Horizontal Line* at the ſame moment of time, they will both of them come to the *Ground* at the ſame time; neither will any diverſity be perceivable in their Deſcent, which GASSENDUS ſaith he hath frequently obſerved.

No other Cauſe of this uniform *motion* can be aſſigned, but the equal propenſion of the *Celeſtial matter*, to withdraw it ſelf from the *Center* of the *Earth*. For tho' the ſaid *Matter* doth always, in an equal ſpace of time, and with all its force recede from the *Center*; yet doth it not wholly exert its Power upon the *Bodies* it meets with, but only that part of it which anſwers, and is equal to the *Body* it lights on. And foraſmuch as there is great difference in *Bodies*, in reſpect of their Compoſition: Some of them are more ſolid than others, having leſs *pores*, which can only admit the moſt *ſubtil particles* of the Matter of the *firſt Element*, and very few only of the *Globuli* of the *ſecond*; ſuch as are *Gold*, *Quickſilver*, *Steel*. And others are more looſe, or leſs ſolid, as *Wood*, and the like, which becauſe they have more lax and open *pores*, do contain more *Celeſtial matter*, and therefore do more readily comply with the *motion* of the *Heavenly Globuli*.

But to Apply this to the matter in hand: If the *Celeſtial Matter*, which is in the *Leaden* and *Wooden Body*, ſhould be taken away from them, and

and that the *Terreſtrial Matter*, which is mixed with the *Heavenly Globuli*, ſhould likewiſe be removed from them, that which remains of the *Celeſtial Matter* in every ſubordinate *Body*, and exerts it force upon the ſame, acts upon the remaining part of the *Terreſtrial Matter*. For the *Leaden Body* being more ſolid, and conſequently more able to reſiſt, ſtands in need of a greater force of the *Celeſtial Matter* to preſs it downwards; whereas that which is leſs ſolid, will be carried down with a leſs force, and conſequently they will both of them come down to the *Earth* with an equal ſwiftneſs. For to the equality of *motion* nothing elſe is required, but that the *Celeſtial Matter* be proportionate to the *Terreſtrial*; which latter, when it is greater, the greater activity is required to overcome its *Reſiſtance*; and when it is leſs, a leſs force of the *Celeſtial Matter* will ſerve to puſh the *Body* downwards.

II. *Why no Body, except it be more heavy than water, doth ſink in the water.*

Wherefore if a *Body* that is more *heavy* than the *water*, be put into it, it preſently ſinks to the bottom; but if it be lighter, according to the different degrees of the ſaid *Lightneſs*, either it *ſwims* on the top of the *water*, or only ſome part of it ſinks into it. Thus an *Earthen Veſſel*, filled with *Air* ſwims upon the *water*; becauſe it is lighter than it, being compared with a like proportion of it. Whereas the ſame *Veſſel*, filled with *water*, ſinks to the *bottom*, becauſe compared with a like proportion of *water*, it is heavier than it. Hence it is that when a *Cup*, with the *Mouth* downwards, is put into the *water*, it doth not go to the bottom, becauſe the *Air* contained in it is the ſame as if it were one *Body* with it, which being lighter than the *water*, muſt needs *ſwim* on the top of it, without ſinking, till the *water* have entred the hollow of it.

III. *Why Gold doth not ſink in Aqua-fortis.*

But this ſeems to contradict another Experiment, whereby we find that the *Grains* of *Gold* and *Silver*, tho' they be more heavy than ſo much of *Aqua-fortis* or *Regalis*, yet do not ſink in it. But this is to be aſcribed to the *Saline Bodies* which are diffuſed through the ſaid *waters*, and which, as it were by a continual chain from the bottom to the top, do ſupport each other, and ſo bear up the *Grains* of *Gold* or *Silver*. That this is ſo, may be confirmed in that, when common *water* is poured to them, after the dropping in of ſome drops of *Oyl of Tartar*, immediately the *Grains* of the *Metal* ſink down to the bottom.

IV. *Liquors that have communication together, are more or leſs heavy, according to the degrees of their height.*

Liquors that have communication by *Pipes* that contain them, do gravitate upon each other, not according to their *Breadth*, but according to their *perpendicular Height*.

The Reaſon is, becauſe theſe *Liquors* are like ſo many hard *Bodies*, put into the 2 Scales of a *Ballance*, whereof the one cannot go down, without cauſing the other to riſe proportionably: For as theſe hard *Bodies*, tho' of unequal bulk, are nevertheleſs of equal weight, when their force is equivalent thereto, ſo likewiſe the *Liquors* contained in *Pipes* that communicate with one another, tho' they be of unequal breadth, yet muſt needs be of equal poiſe, when they are of an equal height. As for Example, in a *Veſſel* of *Liquor*, clos'd on all ſides except only 2 holes, if one of them be fourfold bigger than the other, and a *ſpout* adapted to each of them, the force of one pound of *Liquor*, forcing the *little Spout*, will equal the force of 4 pound weight, forcing the *greater*, which is ſuppoſed 4 times larger than the other, ſo that whatever proportion there may be between the holes, if the force applied to the ſaid *Spout*, or *Pipes* be equal to the holes, the *Liquors* will be in equal poiſe.

V. *When Liquors are ſaid to be of equal poiſe.*

When we ſay that *Liquors* that Communicate together are in equal poiſe, when their heights are equal, this is to be underſtood only, when the 2 Pipes are filled with the ſame *liquor*: For if the *Liquors* be different, their *height* will be in the ſame proportion as their *weight*: So that becauſe QUICKSILVER is almoſt 14 times more heavy than *water*, one thumbs breadth of *Quick-ſilver*, will weigh very near as much as 14 thumbs breadths of *water*.

VI. *Why a Ball falling down from the top of the Maſt into a Ship under Sail, yet falls down plum at the foot of the Maſt.*

A *Stone* or *Ball* falling down from the Top of the *Maſt* of a *Ship* in its full courſe, or toſt up by one that rides on *Horſeback*, falls down at the foot of the *Maſt*, and on the hand of the *Rider*.

The Reaſon is, becauſe the *Ball* in its deſcent or aſcent doth not deſcribe a *Right*, but an *Oblique Line*. For though it ſeem to them who are in the *Ship* to be Perpendicular, yet is it indeed *Crooked* or *Parabolical*. Which any one that pleaſeth may experience by caſting up a *Ball*, or other thing into the *Air*, whilſt he is riding in a *Coach*, for he ſhall find that the ſame, notwithſtanding the progreſſive motion of the *Coach*, will fall directly into his *hand*; but if he ſhall command the *Coach* to ſtop immediately, he will ſee that the *Ball* doth not tend directly upwards, nor fall down perpendicularly, but obliquely, and ſo deſcribes, as it were an *Arch*, or *crooked Line*, the one end whereof will be there where he caſts up the *Stone* or *Ball*, and the other end, where he catches the ſame again. But the Reaſon why the *Ball* appears to him, to tend directly upwards, is becauſe that as much as he moves forward, ſo much the *Ball* is advanced alſo. Now the Cauſe why the *Ball* deviates from a ſtraight *motion* to a cooked is, becauſe its *motion* is derived from a two-fold moving force, *viz.* from that of the *Arm* caſting it upwards, and from that of the *Coach* or *Earth* impreſt upon the *Arm Horizontally*.

VII. *Square Bodies do unequally deſcend to the Earth.*

All *Bodies* that are not of a *Round Figure*, are carried downwards by an unequal *motion*, as is evident in all *Square*, and other *Ccorner'd Bodies*, which tho' they conſiſt of the ſame *matter*, and are of the ſame *Bulk*, yet differ in their *motion*, and unequally move downwards.

This difference of *motion* is cauſed by their *Figure*; which tho' it cannot be ſaid to be the cauſe of their being preſt downwards, yet doth much conduce to the *diverſity* of their motion. For things that are *Rough*, do more ſlowly fall through the *Water* or *Air*; and the broader their *ſurface* is, the greater reſiſtance do they make againſt the *Body* through which they paſs; becauſe they do not divide it uniformly and ſteddily. Thus *Water* and *Ice*, are kept hanging in the *Air*; and greater *Flocks* of *Snow* congealed by *cold*, are more ſlow in their deſcent than *drops of water*. And it is for the ſame reaſon that *Birds*, with their ſpread *Wings*, keep themſelves pois'd in the *Air*, *viz.* becauſe the *Air* oppoſeth a greater reſiſtance to a ſpread or plain extenſion, and hinders its falling down.

VIII. *Why the Bodies of ſome perſons drowned, do after ſome time, riſe up to the top of the water.*

Drowned Bodies do after ſome ſpace of time riſe from the bottom, and *ſwim* at the top of the *water*.

This Effect is commonly attributed to the breaking of the *Gall*, but this I look upon only as a *Fable*. Wherefore I ſuppoſe that the true Reaſon why *drowned Bodies* riſe to the top of the *water* is, becauſe that the *water* entring into their *Bodies*, doth extend the Membrans thereof; by the expanſion whereof, many other Cavities alſo are opened, which by taking in the *Air*, are diſtended to a greater ſpace: for ſuch *Membrans* as theſe, becauſe of the connexion of their parts, do reject the *water*, and can only be filled with *Air*. By which means the *Bodies* having got greater extenſion, and made more light are driven upwards, and ſo *ſwim* on the top of the *water*.

IX. *New laid Eggs are heavier than ſtale ones.*

In like manner it is the entring of *Air*, that makes *Eggs* to be lighter when they are *ſtale*, than when they are *new laid*; for when they are *newly laid* they are top-full with their own *ſubſtance*, without any *air*; but when they grow *ſtale*, ſome *particles* of the *White* and *Yolk* do exhale, and leave an *empty* ſpace, into which the *ſubtil Air* enters, and it may be the more groſs alſo, through the *pores* of the *Shell*; ſo as that it muſt not ſeem ſtrange to us, if they do not ſink in the *water* as deep as they did when *newly* laid.

X. *Why the dead Bodies of Men ſwim with their Faces upwards, and thoſe of Women with their Faces downwards.*

Accordingly alſo, the reaſon is evident why *Female Bodies ſwim* on the *water* with their *Faces* downwards, but thoſe of *Men* with their *Faces* upwards. For *Women* having greater *Bellies*, and more *Cavities* in them, beſides their *Breaſts*, which are of a *Spungy Subſtance*, do take in more *water* in thoſe parts, and therefore by the weight thereof are turned with their *Body* downwards: Whereas *Men* have more narrow *Bellies*, leſſer *Breaſts*, and ſtrait *Urinary Paſſages*, with large *Lungs* and broad *Shoulder-blades*, which are the cauſe why their *Bodies* ſhould *ſwim* with their *Faces* upwards.

XI. *How Men may beſt hinder themſelves from drowning.*

Wherefore Men, if whilſt they are *ſwiming*, they find themſelves in danger of being *drowned*, they can do no better for the avoiding of that danger, than to extend their *Cheſt*, and hold their *Breath*. And therefore *Fiſhes*, that they may *ſwim* with the more eaſe, have *Bladders* blown up with *Air* in their *Bellies*. And in like manner *Bees*, that they may the more lightly hover in the *Air*, have the Trunk of their *Body* fill'd with *Air*.

XII. *Burnt Bricks are heavier, than they were before they were burnt.*

It is found by Experience, that *burnt Bricks* are heavier than unburnt.

The Reaſon whereof is, becauſe the *pores* of unburnt *Bricks* are wider, and filled with *Air* only after that they are dried: Whereas *Bricks* after that they are *burnt*, have many *Cavities*, of ſuch a bigneſs as is fit to admit the *particles* of *water* that run into them, when they are expoſed to the *Air* to be cooled. For there is always great ſtore of theſe *particles* in the *Air*, and which intruding themſelves into the *pores* of the *Bricks*, do encreaſe their *heavineſs*. A confirmation whereof may be, that if the ſame *Brick* be weighed as ſoon as it comes hot out of the *Brick-kill*, it will be found more light, than after it hath been for ſome time expoſed to the *Air*; and if afterwards it be put into the *water*, it will ſtill be found more heavy, becauſe the *particles* of the *water* which are entred into its *pores*, cannot get out.

XIII. *A Stick thruſt into the water, mounts up with ſo much the ſtronger force, as the water is higher.*

If a *Stick* be plunged into the *water* perpendicularly, it riſeth up again with the greater force, as the *water* is higher.

The Reaſon of this is to be fetched from the nature of *Gravity*: For ſeeing that the *Stick* cannot move upwards, but only in as much as it is driven up by the *water*, it muſt follow that the greater the force of the expelling *Body* is, ſo much the more ſtrongly the *Stick* muſt riſe out of the *water*: Now this force is by ſo much encreaſed, by how much the *weight* of the expelling *water* is greater, by the force whereof it drives up the *Stick*; and therefore it follows, that the higher the *water* is, with ſo much the greater force is the *Stick* driven upwards, and ſo much the ſwifter it aſcends.

XIV. *Bodies deſcend by unequal numbers.*

The motion of *Heavy Bodys* is encreaſed according to *uneven* numbers: As if ſuppoſe a *Stone* fall down one *Ell* in the firſt moment of time, in the ſecond it will fall 3, in the third 5, and in the fourth 7, and ſo on according to the following uneven numbers.

The Reaſon whereof ſeems to be, becauſe the *heavy Body*, in the firſt moment of time hath by little and little acquired *one* degree of *ſwiftneſs*. Wherefore at the beginning of the ſecond Time, having that degree of *ſwiftneſs* which it acquired, it will paſs through as much ſpace again, as it did in the firſt moment; and moreover by little and little acquiring force by its *weight*, by means whereof it paſſeth alſo through an equal ſpace to that which it meaſured during the firſt moment; it muſt needs follow, that being now moved by both theſe forces together, it will paſs through a *triple* ſpace to that it paſt at firſt. At the third moment of time likewiſe it hath two degrees of *ſwiftneſs*, whereby it meaſures *four times* as much ſpace as the firſt was. And in the mean time alſo by this innate *Gravity*, whereby it is continually preſſed, doth acquire another degree, whereby in like manner it meaſures the ſpace of another *Ell*. Being therefore thus furniſht with three degrees of ſwiftneſs, it paſſeth through 5 *times as much* ſpace, as it paſt at the beginning; and ſo afterwards continues to make its progreſs by uneven *numbers*, becauſe the acquired degrees of ſwiftneſs always continue the ſame, as well as its natural *heavineſs*.

The Times being 1,2,3,4,5, 6, 7, 8.
The Intervals or Spaces are 1,3,5,7,9,11,13,15.

XV. *Whether Dead Bodies be more heavy than Living.*

It is the common received opinion, that the *Bodies* of *Animals*, after *death*, are more heavy than when alive.

The Cauſe of this change is commonly attributed to the want of *Vital* and *Animal Spirits*; which being ſuppoſed, not only to be active, but alſo very light, do ſeem to diminiſh their *Gravity*. And foraſmuch as *Flame* is lookt upon as the moſt light of all *Bodies*, no wonder if ſome have aſcribed the *Lightneſs* of *Living Bodies* to that *Flame*, which being diffuſed through the whole *Body* of the *Animal*, doth vivifie it, and is therefore called *Vital*. But however, notwithſtanding, this Reaſon ſeems probable, yet I would have us rather truſt to Experiment, than to this *Reaſon*. For Mr. BOYLE, for a *trial*, weighed a *Mouſe alive* with a *Packthread* tied about its *Neck*, where-

wherewith it was ſtrangled immediately after, and when dead, was found to have loſt of its former weight $\frac{7}{10}$ of a grain. And the ſame thing was experimented by him in a *Whelp*, which alive weighed 10 or 11 *ounces*, and being ſtrangled, was found 4 *grains* lighter. Which *Experiments* abſolutely contradict the common opinion, that *Dead Bodies are more heavy than living*, and that by the loſs of *Spirits* they acquire a new degree of *Gravity*.

XVI. *An Arrow mounts and falls with the like ſwiftneſs.*

An *Arrow ſhot* into the *Air* upwards, deſcends from its point of Elevation with the like ſwiftneſs, as it was *ſhot* up thither by the *Hand* of the *Archer*, tho' not in the ſame manner.

The *Reaſon* is, becauſe an *Arrow*, in the beginning of its *aſcent*, is not carried with more ſwiftneſs, than towards the end of its *deſcent*: Nor on the contrary more ſlowly towards the beginning of its *Deſcent*, than at the end of its *Aſcent*, and therefore it is neceſſary that the *Deſcent* of the *Arrow* ſhould be as ſwift as its *Aſcent*.

XVII. *Square Pieces of different matter, being laid upon one another, deſcend equally.*

A *ſquare piece* of *Wood*, and another of *Lead* being let fall ſeverally, make an unequal *deſcent*, but if the *Wooden Square* be laid upon the *Leaden*, they will both *deſcend* with equal ſwiftneſs.

The *Reaſon* why a *Square Piece* of *Wood*, and another of *Lead* do deſcend unequally is, becauſe beſides the force of the *ſubtil matter* driving downwards, there is a greater force in the ſquare piece of *Lead* to reſiſt the *Air*, than there is the *Wooden Square*. For if the *ſquare* piece of LEAD be of 16 *pound* weight, and the *Wooden Piece* of 1 *Pound*, and the reſiſtance of the *Air* as two, foraſmuch as both the *Cubes* are ſuppoſed to be of the ſame *magnitude*, the Proportion of the *Lead*, muſt have the ſame proportion to the reſiſtance of the *medium*, as 16 to 2, and of the *Wooden Cube*, as 1 to 2. And therefore it is neceſſary that the *Leaden Cube* ſhould fall down more ſwiftly: but when the *Wooden Cube* is laid upon the *Leaden*, ſo as that no *Air* comes between them; the *Gravitation* of them both muſt needs be equal, ſince they have both the ſame *Reſiſtance*, and the *medium* makes way for them both at once.

XVIII. *Why water mounts upwards through the Leak of a Ship.*

Water, like to *Light Bodies*, mounts upwards through the *Leaky Bottom* of a *Ship*.

For ſeeing that *Water* is *heavy*, and preſſeth upon the *Body* it lies upon, it cannot be but that the *water* which flows about the bottom of the *Veſſel*, muſt be thruſt away by the *water* that lies above it. For the parts of *water* which are above, preſs downwards by their *weight* or *heavineſs*, and force that which is under them, to enter through the Leak into the *Ship*; ſo that if there was a *Pipe* fitted to the ſaid holes, there is no queſtion but the *water* would riſe up through the ſame, as it doth in *Fountains*.

XIX. *Whence the different heavineſs of Bodies doth proceed.*

Bodies are very different from one another in weight; as *Quickſilver* is much more *heavy* than *water*; neither are there any *metals* but differ from each other in this *Quality*. Thus *Gold*, if we will believe GASSENDUS, is 10 times heavier than *Earth*; Lead, 7 *times*; Silver, 5 *times*; *Pewter* or *Tin*, 4 *times*; *Loadſtone*, 3 *times*, *Whetſtone* as heavy again, *&c.*

And foraſmuch as it is frequently of great uſe, to know the *weight* or *heavineſs* of ſeveral *Bodies*, I ſhall here ſubjoin a Table, exhibiting the juſt *weight* of different Bodies, according to the *Paris weight* that every Square Foot of them weighs.

A Cubical Foot of	Pounds
Water	72
Wine	$70\frac{4}{5}$
Oyl	66
Tin	$532\frac{4}{5}$
Iron	575
Copper	648
Silver	744
Lead	828
Quickſilver	$977\frac{1}{7}$
Gold	1368
Earth	$95\frac{1}{2}$
Bricks	130
Sand	132
Stone	140
Marble	252
Iriſh-ſlate	156
Salt	$117\frac{2}{2}$
Honey	$104\frac{2}{5}$
Wax	$68\frac{11}{8}$
Air	$\frac{4}{5}$ of an ounce.

All which different degrees of Ponderoſity of *Bodies* proceed from the various Make and Texture of their *parts*, whether inward or outward. For it cannot be queſtioned but that there be many *Pores* between the *Particles* of all Bodies, through which the *ſubtil matter* paſſeth continually from the abundance or fewneſs whereof the diverſity of *Bodies* doth ariſe. Hence it is that *Quickſilver* is found to be ſo much heavier than *Water*, becauſe it hath fewer of theſe *Pores*. For tho' we may imagin, that *Water* and *Quickſilver* conſiſt of parts that are of the ſame bigneſs, and that their motions are alike, yet will their diverſity clearly appear to us, if we conſider the *particles* of *Water* to be like a ſoft and ſlack *String*, and the parts of *Quickſilver*, as having fewer *Pores*, to be like hard twiſted *Strings*, that are much more ſtiff and hard. And the ſame is to be underſtood of thoſe *metals* which are ſeveral times heavier than the *Earth*, ſince that all difference proceeds from the multitude or paucity of their *Pores* that admit the *ſubtil matter*, and do variouſly dilate and contract themſelves in compliance with its motions.

XX. *Lead ſeems more heavy while it paſſeth through one Body, than through another.*

Lead ſinks more ſlowly in the *Water*, than in the *Air*; and a *Log* of *Wood* which is very burthenſom to the party that carries it, reſts on the ſurface of the water, and ſcarcely ſeems to be of any weight at all.

A twofold *weight* may be underſtood to be in Bodies, the one *Abſolute*, and which is not ſubject to any alteration, as being indiſtinguiſht from the Body, and cannot be encreaſed, but by the addition of parts to it. Thus *Gold* is heavier than *Lead*, becauſe its *parts* lie more ſnug and cloſe together, and have ſtraiter *pores*. The other *weight* of Bodies may be called *Relative*, which varies according to the different poſition of the matter; and according to this notion of *Gravity*, *Lead* is ſaid to be leſs heavy in the *Water* than in the *Air*; becauſe the *water* doth more ſtrongly reſiſt it, and by that means detracts much from its weight. Thus *Wood ſwims* upon the top of the *Water*, and doth not ſink till it putrifie and corrupt, be-

becauſe the *water* is heavier than *wood*, and drives it up to the *ſurface*. For the *parts* of *water*, in the ſame bulk, are more than twice as many as the *parts* of *wood*; and according to the Laws of *Nature*, *Things that exceed in number, cannot be driven forwards by thoſe that are fewer*. Thus it hath been obſerved, that a *Young man* that weighed 130 pounds, did not weigh in the *water* above 8 Ounces.

XXI. *How we may know the different weight of Bodies.*

And on the contrary, if a *heavy Body*, as for Example *Copper* do much exceed *water* in ponderoſity (for it is accounted to be 9 times heavier than *water*) it will loſe a *9th* part of its *Gravity*. So that if *Copper* ſhould be hung up by a ſtring firſt in the *Air*, and afterwards in the *Water*, then the *9th* part of the weight is to be removed out of that *Scale* which hangs in the *Air*, that there may be an Equality. And by this means we ſhall eaſily perceive the true weight of every *Body*, and how much more heavier it is than the *water*.

XXII. *The different Heavineſs of Bodies in the Air, and in the Water.*

So in like manner it happens that thoſe things, which when weighed in the *Air*, are in equal poiſe, do loſe the ſaid Equality when put into the *water*, by Example *Copper* and *Lead*: For *Lead* put into the *water*, takes up a leſs ſpace than *Copper* of the ſame weight; and therefore when both theſe *Bodies* are weighed in the *water*, the *Lead* muſt of neceſſity out-weigh the *Copper*, with which it was in equal poiſe in the *Air*. And by this means it will not be difficult, to know what *Metals*, according to their bulk, are heavier than others. For if when they are weighed in the *Air*, neither of them exceed the other in *weight*, and that when put into the *water*, they are not in the ſame equal poiſe, that which out-weighs the other, according to its bulk, muſt be ſuppoſed heavier.

XXIII. *Reſpective Gravity may be changed; but abſolute cannot.*

Whence it follows, that the *reſpective* Gravity of a *Body* may be changed, whilſt the *abſolute* ſtill continues the ſame: As ſuppoſe we put into one of the *Scales* of a *Balance* 100 Pounds, and in the other 50, then the abſolute Heavineſs of the firſt weight will be always of 100 Pounds; but the reſpective Heavineſs will be only of 50 Pounds; nay, it will be no more than 20 or 30 Pounds, if we put in the other *Scale* a *Body* of 80 or 90 Pounds. And for the ſame Reaſon, if we hang the weight of 100 Pounds at the end of a *Standard*, tho' the ſaid abſolute weight continue, yet may the reſpective be changed every moment; according as the weighing *Body* is nearer or farther from the fixed Point, than that weight is, which is at the other end of the *Standard*.

XXIV. *Heavy Bodies increaſe their motion in falling.*

Heavy Bodies do not move equally in their Deſcent, but accelerate their *motion*; as is evident in *Stones*, which according to the greater diſtance from whence they fall, make the ſtronger impreſſion upon the things they light on.

The Reaſon is, becauſe a *Body*, at the beginning of its motion, moves but little; for the *ſubtil matter*, which takes up its place, and which alone acts upon it, does not drive it downwards with that ſwiftneſs wherewith it endeavours to withdraw from the *Center*: But when the *Body* begins to deſcend, the *ſubtil matter* which is under the *Body*, and which with great endeavour ſtrives to get above it, doth continually drive it downwards, and adds new degrees of Swiftneſs to thoſe it had before.

Or elſe we may ſay, that the *motion* of Heavy things is accelerated; for that *Bodies* in their deſcent do acquire a new Force. For tho' they paſs but ſlowly at the *firſt* moment of their motion; yet at the *ſecond* they muſt move more ſwiftly, becauſe they retain their former motion, and receive an augmentation of it from the *Action* of the moſt ſubtil Matter.

XXV. *A Bullet driven through a Pipe or Bore, moves unequally.*

Thus when a *Bullet* or *Pellet* is by the blaſt of our *breath* driven through a *Pipe*, the *Breath* that proceeds from our *Lungs*, doth with repeated Onſets ſtrike againſt it, whereby the firſt impulſe impreſt upon it is increaſed, and new degrees of Swiftneſs added thereto, whereby it becomes more vehement than it was at firſt.

XXVI. *Why Water falls down unequally through Pipes.*

Hence it is alſo, that the *water* which by Example is fallen down 3 Foot and an half, hath its Force once and half as much increaſed, more than that *water* which hath made a deſcent of one Foot only; and that conſequently the *water* which guſheth out of a *Pipe* fill'd to the height of 3 Foot and an half, muſt run twice and an half faſter, than when it runs from a *Pipe* that is only full to the height of one Foot; for that by that time it is come to the end of the *Pipe*, it will have acquir'd in its deſcent twice and an half more Swiftneſs, than it would have got, if it had only made a deſcent to the *4th* parth of the *Pipe*.

XXVII. *The acceleration of motion is performed by the acquiring of a new degree thereof.*

Nevertheleſs, we muſt not imagin that the motion of *Heavy Bodies* doth increaſe continually, ſo as to have no bounds of its *augmentation*: For the *Air* reſiſts the motion of *Bodies*, and blunts their force. Hence it is that a *Bullet* diſcharged from a *Canon* at a great diſtance, doth leſs hurt, than if it were ſhot nearer. And ſo likewiſe we ſee in the *Pneumatick Engin*, that when all the *Air* is pumpt out of it, *heavy Bodies* do fall with a great force at the firſt, and do exert the entire force of their *Gravity*: Like as *Bodies* caſt up into the *Air*, in the beginning of their motion, do exert the whole Swiftneſs they have received.

XXVIII. *Why a Pail is not heavy in the water.*

A *Pail* full of *Water*, in a *Well* or *Pool*, loſeth all its *Gravity*; ſeeing that with the leaſt force it may be removed, this way or that way, upwards or downwards, without almoſt any perception of ponderoſity.

The Reaſon is, becauſe the *parts* of *water*, whilſt they are mingled and hang together, do do not preſs one another; for being all of them equally ſolid, they are all equally preſt towards the *Center* by the *Celeſtial matter*; and therefore the *Pail*, becauſe of their equal preſſure, is with the leaſt force moved any way. In like manner a man that is *ſunk* under *water*, is not ſenſible of any ponderoſity; becauſe the *Waters* which lie upon him, are leſs preſſed by the *Heavenly Globuli* that run between them, than the *man* himſelf, who is a more ſolid *Body*, and conſequently leſs pervious to the *ſubtil matter*.

Which is the Reaſon why *Divers* cannot come to the bottom of the *Sea*, without *Weights* hung upon them; becauſe they are equally preſſed by the *water* that ſurrounds them, and as much born up by that which is beneath them, as they are thruſt down by that which is above them. So that if a *Diver* being at the bottom of the *water*, could apply and faſten to his *Arm* or *Thigh*, the lower part of a long *Pipe*, the other end thereof ſtanding

ſtanding out above the *water*; ſo that the *water* could not come in between them, that part of his *Body* would preſently begin to ſwell, it being free from the preſſure of the *water*, and the *Blood* would run thither from the other parts of the *Body*.

XXIX. *A Body is more hindred in its deſcent, by Running-water.* Hence it is alſo that a *Body* is more born up by *Running-water*. For the force of ſwiftly *Running-water*, doth make the ponderoſity of the *Body* almoſt inſignificant; as we ſee in things that are thrown or caſt upwards. Wherefore we find, that a *Body* doth more eaſily ſwim on the top of *Running-water*; becauſe there are many more parts of the *water* that reſiſt its ſinking, ſince continually other new parts ſucceed to ſupport and keep it up. And this is the foundation of the *Art* of *Swimming*.

CHAP. V.

Of Taſte.

I. *Hard Bodies, as Stone, Iron, and the like, are inſipid.* HArd *Bodies*, ſuch as *Stone*, *Iron*, *Lime*, *Hartshorn*, *&c.* are inſipid, and do not at all affect the *Tongue*.

Becauſe the *particles* of *Hard Bodies* cannot be ſeparated from each other, and conſequently be mingled with the *Spittle* in our *Mouths*. For when *Bodies* are ſo compact that they cannot diſſolve and furniſh thoſe *particles*, which by the Vehicle of *Moiſture*, may be conveyed into the *pores* of our *Tongue*, no wonder if they be *inſipid*. For tho' *Sugar*, when melted, affords a *ſweet taſte*; yet when the ſame is brought into ſolid and compact pieces, it affords no taſte at all, becauſe its parts cannot readily be ſeparated, to impreſs any taſte upon the *Organ*. So for the ſame Reaſon *Pills*, when they are ſwallowed whole, are ſcarcely perceived, becauſe they do not ſtay long enough to have their outward parts diſſolved, without which they cannot affect the *Organ* of *Taſte*.

Thus *Turpentine* boiled, and made into *Powder*, is lookt upon to be inſipid; becauſe the more *ſubtil parts* of it cannot be diffuſed or mingled with the *Spittle*: Whereas in its Liquid form, it exhibits a *bitter taſte*. So that Experience teacheth us, that nothing elſe is wanting in theſe *Bodies*, to make them Savoury, but only the diviſion of their *parts*; ſeeing that the *Salts* which enter the Compoſition of *Glaſs*, were ſavoury before they were compacted into that hard conſiſtence, and that *Metals* reduc'd into very ſmall *powder*, tho' before they were inſipid, do now yield a moſt ſtrong and intolerable *taſte*.

II. *Why Bodies are diſtinguiſht by Taſte.* Almoſt all *Bodies* are diſtinguiſhable by their *taſtes*; as *Honey* is ſweet, *Wormwood* bitter, &c.

The general Cauſe of all *Taſtes* and *Savours* depends on the *greatneſs* and *figures* of the parts of *ſavoury Bodies*, which are capable of being diverſified after an infinite manner of ways: And foraſmuch as *Bodies* are in a manner all of them compoſed of *parts* that are of a different *bigneſs* and *figure*, it muſt not ſeem ſtrange to us, that we meet with ſo great a variety of *Taſtes*.

III. *Hot Meat is more ſavoury than cold Meat.* This difference of *Taſtes*, is ſometimes cauſed by the various agitation of the *parts* of *Bodies*; for we experience that *hot Meat* is more ſavoury than *cold*, becauſe *heat* increaſeth the motion of the *parts* of the *Body*; and beſides, it is certain, that the more any *Body* is moved, the more fit it is to move another *Body* that toucheth it: And therefore it connot ſeem ſtrange, that *Meats*, when hot, are a great deal more *ſavoury* to us, than when they are *cold*. This is the Reaſon alſo why *dreſſed Meats* are far more *ſavoury* than raw, becauſe the *heat* of the *fire* that dreſſeth them, divides them into leſſer parts, whereby their *figures* are changed, and ſo make them to be of a very different Taſte from what they were, when *Raw*.

IV. *Sweet things do ſooner cloy the Stomach, than Meat of a ſharp taſte.* *Sweet things* do ſooner fill than *ſharp*. Thus we find that *Milk-meats*, *Sweet-meats*, *Butter*, *Honey*, *&c.* do ſooner ſatisfie our *Appetite*, than *ſowre* and *ſharp things*.

Some ſuppoſe the Cauſe hereof to be, becauſe *Sharp things* do afford little *Nouriſhment*, and much *Excrement*; but this Reaſon ſeems of no force, becauſe *Digeſtion* does not immediately follow upon the taking down of our *food*: But the Cauſe why *Sweet things* do ſooner glut the Appetite, than *ſharp* and *ſowre* things is, becauſe theſe latter are made up of parts whoſe ſurface is very *rough* and *rugged*, that is, which have many *Angles* or *Inequalities*, which make them fit to twitch and vellicate the *Bodies* they touch or apply to; and by this their vellicating of the *Stomach*, do ſtir up the *Appetite*: Whereas *Sweet things* conſiſting of *ſmooth Bodies*, and ſuch as gently affect the *Stomach*, without exciting of the *Appetite*, do preſently fill and ſatiate.

V. *The Fire excites a ſharp taſte in Meat dreſt by it.* *Fire* procures a *ſharp Taſte* to Meat; for we find that *Roſt-meat* doth with more ſharpneſs ſtrike the *Tongue*, and affords a more grateful *taſte*.

For it is evident that there is no *food*, but contains ſome *Salt*, which is in a manner equally diffuſed throughout the whole Maſs of it. Whence it is, that when *Meat* is agitated by the *heat* of *fire*, ſome part of this *Salt* is carried to the outſide, and exhales with the other Liquid parts, and conſtitutes that *Smoak* which we ſee proceeds from *Meat* that is a *Roaſting*. But whereas they are only the *inſipid particles* that fly into the *Air*, thoſe of the *Salts* can ſcarcely riſe 2 or 3 *fingers* high; but that by their weight they are forced down again to the *ſurface* of the *Meat*, and there produce that *ſharp taſte* which we experience in *Roaſt-meat*.

VI. *Sowre and Harſh things ſet the Teeth on edge.* Things *harſh* and *ſowre*, ſet the *Teeth* on edge; as *unripe Fruits*, *harſh Wines*, *Verjuice*, and the like.

The Reaſon is, becauſe the fixt *Salts* that are in theſe *Bodies*, being entangled in a groſs *Sulphur*, compoſe together with it parts, whoſe *Surface* is briſtled with many *Hairs* variouſly bent, which entring into the *pores* of the *Tongue*, ſhut up the parts thereof.

VII. *Why Bitter things do heat, and Sowre, cool.* *Bitter things*, as *Orange-Peel*, *Venice-Treacle*, and many *purging Medicins* do heat; but *Sowre things*, ſuch as *Juice of Orange*, *Sowre Grapes*, *&c.* do *cool*.

Becauſe *Bitter things* conſiſt of *ſharp Salts*, and *groſs Oils*, which being agitated together, do excite and preſerve *heat*; whereas the parts of *Sowre things* are long, ſtiff and pointed, and rather ſtop the motion of the *fiery particles*, than promote it, and for that Reaſon are eſteemed of a *Cooling Nature*.

VIII. *Why unripe Grapes and Fruits are harsh.*

Unripe Fruits seem very harsh at the first *taste*, and cause a Roughness on the *Tongue*; but afterwards they turn *sweet*, and acquire a pleasant relish.

The Reason is, for that *Fruits*, before that they are *ripe*, do consist of longish parts, which by their motion do, as it were, cut the *fibres* of the *Tongue*, and contract them; and afterwards they grow ripe by means of the *fire* or the *heat of the Sun*, which digests their raw *Juice*, and by exhaling the Heterogeneous parts, reduceth it to *sweetness*. For it is evident, that there is a continual resolution and division of parts in *Fruits* that tend to maturity, by means whereof they lay aside their hardness and harshness, and after perfect Concoction become soft and pleasant.

IX. *A Tongue that is either too dry, or too moist, can taste nothing.*

A *Tongue* that is parch'd and over-dry, hath little or no *taste*; and so likewise when it abounds with over-much *moisture*.

The Reason is, because *Taste* doth not only consist in *moisture* or *driness* apart, but in a mixture of them both. And therefore it is no wonder, if a *too dry* and parched *Tongue*, cannot perceive the *taste* of solid *food*, seeing that the same cannot be macerated or dissolved without *moisture*, which is necessary in order to the Sense of *Tasting*. For the *Tongue* being a spongy and porous part, stands in need of *moisture*, which is the *vehicle* of *Savours*. Moreover, in a dry *Tongue* the *fibres* are too much contracted, and thereby are made unfit to receive that affection which the *savour* of things doth impress on it. And on the other hand, a *Tongue too moist*, is not fit for the reception of *Tastes*, foraſmuch as the *Tongue*, which is loose and spongy, having its *pores* already filled with *Humour*, cannot well admit that which conveys the *Savoury particles* of the *food*, and by this means cannot perceive the *taste* of it. And it is for this very Reason, that we cannot relish *Wine* after having eaten some *sweet* thing, and that in order to recover our *taste* we eat *salt meat*, that may open the *pores* of our *Tongue*.

X. *Why we find no relish in those things which we eat often.*

Some find that they lose the relish of those things, which they feed too frequently upon, and that either because these common *Aliments* do leave some of their *particles* in the *Tongue*, which render the little Nipples of it immoveable; or, because the *Soul* gives less heed to those *motions* that are ordinary and common, than to those which are new and unfrequent.

XI. *Why we can better discern Tastes in the Morning.*

Tastes are better discerned in the Morning, especially before we have eaten or drank any thing, that can byass the *Tongue* to a mistaken Verdict.

Because at that time the *Tongue* is like fair *Paper*, and as yet unting'd by any *Savours*. For that which receives, must be free from a *Taint* of the thing received. Which is true not only in the *Taste*, but also in *Hearing*, *Smelling*, and all the other *Senses*: For by right, the Sense of *Hearing* is sharpest, and *Blind men* do better retain things than others.

XII. *Persons sick of the Jaundise, cannot rightly discern the taste of things.*

Men sick of the *Jaundise*, suppose all things to taste *bitter*.

The Reason is, because the *Gall* is diffused through their *Tongues*, which infects their *Spittle*; for the *Gall* consisting of sharp *particles*, doth so corrupt the *Spittle*, that it communicates a bitterness and an ungrateful *taste* to all the Food that is eaten, as if something of *Soot* were mixt with it. The Cause of which Depravation is, because the *Raw humour*, which runs through the *Veins* and *Arteries*, betakes it self to the *Tongue*, because of its loose and spongy Flesh, and filling the *pores* of it, vitiate the *taste* of all received *Aliments*. Which is the Reason why *Physicians* commonly order their *Patients* to put out their *Tongues*, that they may view the colour and disposition of it; for seeing that that Member, proportionable to its bulk, contains abundance of *Blood*, it accordingly also admits a considerable deal of the *morbifick Matter*, which there discovers it self by its *Colour*, and consequently also the Sickness which disturbs the *Body*.

XIII. *Whence the Harsh taste of Verjuice doth proceed.*

The *Juice* of *unripe Grapes* constitutes that which is called *Verjuice*, which is of a *sowre* and somewhat harsh *taste*; whereas the *Juice* of *ripe Grapes* is *sweet*, and with a pleasant briskness accosts the *Palat*.

The harshness of *Verjuyce* proceeds from the Roughness and Inequality of its *parts*; for because the Juice of *unripe Grapes* is not sufficiently concocted, they retain a great deal of Crudity, which is owing to their long and inflexible *particles*.

Hence it is that the *Verjuice* which is made of *Crabs*, is a good *Medicine* to help the weakness of the *Eyes*; because its *particles* being like so many little *grains* of *Sand*, do wipe off the filth of the *Eyes*, and by this means restore the Visive faculty to its former clearness. And the same Reason may be given of the *Water* of some particular *Fountains*, which by reason of their *Acrimony* do not only *purge* the *Eyes*, but also the *Optick Nerves*, that so the *Rays* of *Light* may be the more freely transmitted.

XIV. *Why New Wine is sweet.*

But *New Wine* is *sweet*, because it hath been sufficiently decocted by *Heat*, and all its *parts* are smooth and even. And as to its muddiness, that is only caused by those *Heterogeneous parts*, which are not yet separated from it; which as soon as they are either precipitated to the bottom, or raised up to the top, by *fermentation*, the *Wine* becomes clear, by admitting the *Heavenly Globuli*.

XV. *What is the Cause of that variety of Tastes which is in Fruits.*

All *Fruits* are distinguishable by their *taste*, some of them having a *harsh bitter taste*, others a *harsh sowre*, other a *sowre*, and all of them a *sweet taste* after they attain to their full *maturity*.

This difference of *Tastes* in *Fruits*, proceeds from the various Texture of the *particles*, and the different structure of the *Plants* that bear them. For *grafted Trees* bear more delicate *Fruits* than others, because the *Alimentary Juice* is more exactly strained through the double twisting and weaving of their *fibres*. The *Harsh-sowre taste* therefore of *Fruits* proceeds from this, that their Parts are not yet sufficiently straitned and digested; and because the *surface* of them, as was said, is bristled with many little *Hairs*, diversly bending this way and that way, which entring into the *pores* of the *Tongue*, do shut them up. As we find in the *taste* of *Quinces*, *Medlars*, and generally of all *unripe Fruits*. Other *Fruits* afford a *smart* or *sharp taste* to the *Palat*, because their *particles* are long, stiff, and very subtil; by which means they prick

XIII. *Whence the Harsh taste of Verjuice doth proceed.*

XIV. *Why New Wine is sweet.*

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prick and divide the *Tongue*, and dilate the ſame with ſome kind of ſenſe of *heat*. *Ripe Fruits* do generally afford a *ſweet taſte*, becauſe the *Juice* of the *Plant* whence they proceed hath been well ſtrained, and loſt all its Crudity by the agitation of the *heat* of the *Sun*. Wherefore alſo ſuch *Fruits* as theſe do pleaſingly ſmooth and ſtroak the *Tongue*, and with a grateful ſoftneſs enter the *pores* of it.

XVI. *Whence it is that the ſame Food is not equally grateful to all.*

Nothing is of more obvious Experience, than that the ſame *food* is not alike grateful to all; and that frequently what is very pleaſing to ſome, is very diſtaſteful to others.

Which proceeds from the different diſpoſition of the *Organ*. For they whoſe *Tongues* are furniſht with ſtiff and leſs plyant *fibres*, will be leſs exact in diſcerning the *Taſte* of things, becauſe they ſtand in need of a greater Force to move them: Whereas thoſe whoſe *fibres* are more delicate and tender, do more exactly diſtinguiſh them, becauſe the leaſt Vellication is ſufficient to affect them. Somewhat like that which is found in the *hands* of thoſe that are grown hard by much labour, which without any ſenſe of Pain do handle *Briars* and *Thorns*, when thoſe that have tender *Hands* cannot, without great pain, ſo much as touch them.

XVII. *Why the ſame thing ſeems ſometimes to have a different Taſte.*

Hence it is that ſometimes the ſame perſon, upon ſome alteration in the *Organ of his Taſte*, cauſed by Age or Sickneſs finds a different Taſte in the ſame Objects from what he formerly perceived in them: For the Texture of his Organ being changed, the *particles* of the *Bodies* do no longer accord with it, but cauſe a kind of rout and confuſion in it. And it is for the ſame Reaſon that young *Women*, and ſuch as are with *Child*, do ſometimes take delight in ſome *Meats* which they formerly abhorred.

XVIII. *Why different men, affect different Sawces.*

Whence it is that different *men* are pleaſed with different *Sawces*, and that there muſt be different *Sawces* to pleaſe the ſame perſon at different times and ſeaſons. For one loves *ſweet Sawces*, others *ſowr*; one man delights in the *taſte* of *Wine*, another abhors it; and the ſame perſon that is greatly pleaſed with the *taſte* of it, when he is in Health, doth loath it when he is ſick of an *Ague* or *Fever*, becauſe the *fibres* of his *Tongue* are otherwiſe diſpoſed than they were before. This is viſible in *Girls*, and *Women big with Child*, eſpecially in the firſt Months after Impregnation, who frequently delight in, and long for thoſe things which before they abhorred, or at leaſt had no inclination to, foraſmuch as the *particles* of thoſe things enter more ſmoothly, into the *pores* of their *Tongues* than before.

XIX. *The Miſtake of ſome Peripateticks.*

From what hath been ſaid, we have reaſon to conclude, that it is a great Errour to place the *taſte* or *ſavour* of things in the *ſavoury Objects*, as ſome *Peripateticks* do: For beſides that in ſo doing they aſcribe to an *Inanimate Body*, a way of Exiſtence which doth not agree with them, the conſequence of this Opinion is, that 2. Men would never be able to find a *different Taſte* in the ſame Object, which is contrary to Experience. So that we muſt conclude, that the Power of perceiving *Taſtes* belongs to the *Soul*, as well as that of *feeling* Pleaſure or Pain; and conſequently, that *Taſte* is nothing elſe, but a certain *perception* or *ſenſation*, which is exerted by the *Soul*, by the motions which Meats produce in the *Nerves* of the *Tongue*.

CHAP. VI.

Of Smelling.

I. *Animals, by their Senſe of Smelling, diſcover what is good or hurtful to them.*

SO great is the Affinity between *Taſte* and *Smelling*, that they are produced and affect the *Organs* almoſt in the very ſame manner. For we find that *Animals* hunt out their Prey by their *Scent*, and by the ſame diſtinguiſh what is good, from what is hurtful to them. Thus the Smell of *Catmint* allures *Cats*; *Fennel*, *Serpents*; *Bazil*, *Scorpions*; *Rue*, *Weezels*, *&c.* As on the contrary, they avoid what is harmful to them by the help of the ſaid *Organ*. Thus *Serpents* flee from the Scent of *Galbanum*, *Scorpions* abhor *Wolves-bane*; *Flies*, *Brimſtone*; *Goats*, *Bazil*; and *Ants*, *Organy*.

The Cauſe of this *Sympathy*, or *Antipathy*, muſt be derived from the *Organ* of *Smelling*; which receives the diverſity of *Odours*, according to the different affection and diſpoſition of its *fibres*. For if the *Steam* that proceeds from an odoriferous Object, be delicate, and doth ſmoothly affect the *Nerves* of the *Noſtrils*, it will cauſe a *grateful Odour*; but if the ſaid *Nerves* be more rudely ſhaken or vellicated, this gives an unpleaſing *Scent*. For *Odour* is nothing elſe, but the *thin* and *inſenſible* parts of *Bodies*, which being ſeparate from each other, fly up and down in the *Air*, and being by the drawing-in of our *Breath* received into our *Noſtrils*, do excite a motion in the *Extremities* of the *Nerves*. So that the diverſity of *Motions*, produceth difference of *Odours*; and as the *fibres* of the *Organ* are more ſoftly or roughly ſtruck upon, accordingly are they diverſified. For this Reaſon we find, that *Roſes*, *Muſk*, *Ambergris*, and ſuch like, afford a ſweet Smell; becauſe the *Steam* that proceeds from them, conſiſts of ſubtil and flexible *Filaments*, which eaſily enter the *Organ*, and without any roughneſs are communicated to the *Nerves*. But *Brimſtone* affords a ſtrong and unpleaſant *Smell*; becauſe of the Ruggedneſs and Unevenneſs of its *filaments*. For *Brimſtone* being very eaſily inflammable, we muſt ſuppoſe it to conſiſt of many fat Steams, which being mingled with a ſharp Matter, do make the *filaments* rough and prickly, which cannot but affect the *fibres* of the *Organ* unpleaſantly and painfully.

II. *How ſweet Scents may be produced from ſtrong and unpleaſant things.*

And on the contrary, when the ſtrong Scent of *Brimſtone*, is dulled by the joyning of ſome other *Body* with it, a grateful *Odour* is produced. Thus tho' *Civet* in a bulk, and by it ſelf, have a very ſtrong Scent; yet if 3 Grains be mixed with 10 Grains of *Ambergris*, and one Drop of the Juice of *Lemons*, and ground together, it will produce a moſt rich and grateful *Perfume*. In like manner, *Muſk*, when it is by it ſelf, yields a ſtrong and overcoming *Scent*; but being mixt with ſome of the *Spirit of Roſes*, it affords a moſt pleaſing and delightful *Smell*. And they who bring *Muſk* from the *Indies*, after that the Smell of it is in great part exhaled, do wrap it up in the *Skin* of the *Animal* from whence it is taken, or in *Bladders*, and hang it up for ſome days in ſome ſtinking place, having firſt made ſeveral Holes in the

the said *Skins* or *Bladders*; and by this means recover the *Musk* to its former fragrancy. Forasmuch as by this Fermentation, its parts are so separated and attenuated, that they cannot but gratefully tickle the Organs of Smelling.

III. *How some Bodies that have litile or no scent, may be made odorous.* And it is for the same Reason, that the *Oyl of Roses*, drawn by *distillation*, being put into *water* in a considerable Quantity, hath almost no odour at all, but being mingled with the *Salt of Tartar*, it makes a fluid composition, whereof some part being put into *water*, yields a very great and sweet *perfume*; the reason whereof is, to be ascribed to the *Salt of Tartar*, which being a very powerful *Alkali*, exalts the *Oyl*, and renders it more volatile, and consequently more proper to be attracted together with the *Air* in *Respiration*.

IV. *To the perception of Odours, some distance is required.* When a *Man* is too near to *odoriferous Bodies*, he cannot so well perceive their *Effluvia*. And therefore it is that *Flowers* do smell more sweetly when they are at some distance from the *Organ*, than when they are too near it.

The Cause is, because the *smell* or *odour* of *Objects* doth not consist in their more gross and moist, as before hath been said of *Taste*, but in their thin and dry *parts*; and therefore he who is too near to the *odorous Object*, doth not only take in the steams that proceed from it, but also those that come forth from the *Earth*. But if he be somewhat further at a distance from it, he receives nothing but the more vivid and *subtil steams*, because the Grosser cannot go far off, but soon fall down to the *Earth* again. Wherefore some distance is necessary, that the more brisk *particles* of the *odorous Object*, may freely and purely exert its power, and excite a grateful *smell*.

V. *Perfumes are least perceived when too near.* Hence it is that *Perfumes* cannot be so powerfully perceived when we are too near to them; for they consisting of nothing else but a steam, flowing from the *odoriferous Body*, by passing through some interval it becomes more purified and discharged from its more thick and terrene *particles*, which dull and allay the sweetness of the *odour*. As we find that *Wine* mixed with *Water* is less tasted, because *water* doth break and allay its force.

VI. *Plants in* Syria *and* Arabia *do far excel ours in smell.* Plants in hot *Countries* shed a far more fragrant *odour* than in *cold*. Thus it is known that in, *Syria*, *Arabia*, the *East-Indies*, &c. many *Spices* are produced, and that the *Fruits* of the *Trees* that grow there, have more lasting and pungent *odours*.

The Reason is, the *heat* of the *Sun* in those *Countries*, which conduceth very much to the briskness and sweetness of *odours*: For by means thereof the *Alimentary Juice* of *Plants* becomes exalted and depurated in the highest degree; and thereby prepared to yield copious matter for those *odoriferous steams* proceeding from the *Leaves*, *Fruits*, and *Flowers* of them. For it is certain that *odours* consist of *Sulphur* or *Salt*, and that those *Bodies* which abound with these, do shed more abundant *odours*. Because heat is a great strengthner and exalter of the *Sulphureous Parts*, causing them to exert their force with greater efficacy; for after that the *watry Humour* is separated, the remaining substance is more throughly concocted, and consequently yields a more fragrant *odour*. And therefore in order to the preserving of this Fragrancy, we make use of *Oyl* wherewith to cover them, or else shut them up in *Boxes*, to hinder the vapour from exhaling continually. For we find that all *odorous Bodies* do smell more strongly when they are *hot*, than when *cold*; in the *Day* time, than in the *Night*; in the *Spring*, than in *Winter*; and in *Summer*, than in the *Spring*, because then their parts are in greater motion.

VII. *Heat conduceth very much to the sweetness of Odours.* For the same Reason it is, that *Fruits* attain a more grateful *scent* by being prepared with fire; and that all things smell sweeter during the *heat* of the *Summer*, than when they are congealed with *cold*; because then their *Sulphureous Parts* are lockt up: whereas in hot *Seasons* the same is agitated and diffused through the *Air*. And therefore we find that there are very few Seeds that afford any sent from them: for being of a very compact substance, and consisting of a clammy substance, they do not easily send forth any *Effluvia*. And on the contrary, we find that *Contusion* or *Bruising* is a great means to excite that sweetness of *odour* which is found in dry things. Thus the pricking of the Rinds of *Citrons* or *Oranges*, renders them much more odorous. And *Spanish Wax*, which is without *odour* before it be put to the *Fire*, becomes very odoriferous, by the resolution of some of its parts into *Smoak*. The same may be said of *Incense*, *Myrrh*, and many other *odoriferous Gums* and *Drugs*, which do not exert their fragrancy till they be dissipated into *Air*.

VIII. *What is the Cause of that sweet or strong smell which proceeds from some persons.* All *Men* do not *smell* alike, for some yield a very fragrant and pleasing *odour*, which *Historians* relate concerning *Alexander the Great*, whose *Sweat* was very pleasing and grateful to all that smelt it. Whereas others *stink*, or scent very strongly; which is observed of *Flat-nos'd Persons*, who are commonly tainted with loathsom steams proceeding from them.

A *Sweet Odour* proceeds from those persons, whose *Alimentary Juice* is exactly and throughly concocted; which then happens, when by the agitation of the *Body*, the *Pores* are opened, to let out the *particles* of any crude *Humours*. The same may also be an effect of the Temperament of *Men*, as when *Heat* is greatly predominant in them; for if the said *Heat* be free, and is disintangled from any superfluous Humour, it cannot fail of producing a *sweet odour*. Now that such was the Temperament of *Alexander the Great*, is evident from his inclination to the excess of *Anger*, the continual exercise of his *Body*, and the smoothness and thinness of his *Skin*. But when on the contrary, the *Alimentary Juice* is not well digested, or by some means or other becomes depraved, this must needs produce an abominable and loathsom *smell*; such as we perceive commonly in *Flat-nos'd Persons*, whose steams are observed to be very nauseous; and that because the *Pores*, through which the *Snot* or *Snivel* is conveyed from the *Brain*, is too much straitned, and by reason thereof *putrifies* and corrupts there. For Corruption is the most genuine cause of *Stinks*.

IX. *Of the various Vertue and Nature of Odours.* And accordingly some *smells* are very refreshing, and conducing to *Health*, whereas other are very inimical to Nature, and our *Vital Spirits*. Thus we are told that there is a People in the most remote Borders of the *East Indies*, about the Springs of the River *Ganges*, called *Astomi* or *Mouth-*

Mouthleſs, who (if we may give credit to ſome *Hiſtorians*) live only by the *odours* they take in from *Flowers* and *Fruits*. So likewiſe it is notorious, that there be many *Scents* which recall Perſons that are in a *Swoond*; and more particularly the ſmell of *Vinegar*: And every body knows how much *Cats* are delighted with the Herb *Nepota*, or *Catmint*; which acceptableneſs and congruity proceeds only from the *odour* of theſe things. And on the contrary, ſome *ſmells* are the cauſe of *diſtraction*, as it is related of the *Sabæans*, that they uſed to be ſtupified by *odours*: And of *Cats*, that they became mad by the ſmell of ſome *Ointments*: becauſe theſe exhalations cauſe ſo violent an agitation in the *Organ*, that thereby the natural Temperament of the *Brain* is deſtroyed, whence proceeds that tumultuary confuſion of the *Spirits*.

X. *Why diſtilled Waters loſe their fragrancy, when the Flowers from whence they are drawn, are in their Prime.*

Roſe and *Orange-flower Water*, with other ſuch like *Waters* diſtilled from *Flowers*, keep their ſweet ſmell all the year, except only when the *Flowers*, from whence they are drawn, are moſt fragrant, for then they loſe their Scent.

The Cauſe whereof is, not becauſe thoſe *Waters* are indeed deſtitute of all *Odour* at that time: but the *Earth* then abounding with *Flowers*, which diffuſe their ſteams throughout the whole *Air*, the *Organ* of *Smelling* is ſo much charged with them, that it cannot be affected with the *ſmell* that proceeds from thoſe *waters*; and upon this account they are ſuppoſed deſtitute of all *ſmell*.

XI. *The Fragrancy of things may be ſeparated from their groſs Body.*

Tinctures, *Eſſences*, &c. of *Roſes*, *Cinamon*, and ſuch like *odoriferous Bodies*, retain the ſame *ſmell*, which the things themſelves had before.

The Reaſon is, becauſe the nature of Odour conſiſts in a certain texture of *Sulphur* and *Salt*. By *Sulphur*, the *Chymiſts* underſtand a Fat and *Oily Subſtance*, which according to its various mixture in various *Bodies* is different. Now ſince this *Subſtance* may by *Chymical Art* be extracted from *Bodies*, it muſt not be thought ſtrange that it retains the ſame *Odour*, which the *Bodies* themſelves before did.

XII. *They who are troubled with Cold, loſe their Smelling.*

They who have got a *Cold*, do in a manner perceive no *Odours* at all.

Becauſe the *Rheum* doth ſo obſtruct the *Pipes* of the *Olfactory Organ*, into which the Odorous Steams uſe to inſinuate themſelves, that they can no longer enter them. For in this caſe the obſtruction ſometimes is ſo great, that there is no paſſage left in the *Noſtrils* to draw ones *Breath*; and therefore it is no wonder, if the *Nerves*, being filled with this humour, cannot admit the Steams proceeding from *odorous Objects*, or if they do, yet cannot receive any due impreſſion from them.

XIII. *Why we perceive the odours of things better in the* Summer *than in the* Winter.

In *Cold Weather*, *odorous Objects* do more weakly affect our *Organ* of *Smelling*.

This is, becauſe in *Winter* time the *pores* are obſtructed and contracted, ſo that their odorous Steams do not then break forth from the *Bodies* to which they belong. To which may be added, that the *Air* is thicker and more groſs at that time, which therefore the *odorous Steams* are leſs able to penetrate. Hence it is that *Congealed Bodies* ſhed no fragrancy or *ſmell* at all, becauſe by reaſon of the obſtruction of the *Pores*, the *Steam* cannot diſperſe it ſelf in the *Air*, nor affect the *olfactory Organ*. Whereas on the contrary, in the *Summer-time*, *ſmells* are much better and ſtrongly perceived, becauſe the intenſe *heat* doth then agitate and excite the *particles*, and ſends them in greater abundance to the *Organ*. We obſerve alſo, that according as the *wind* is for or againſt us, ſo we either *ſmell odorous Objects*, or not ſmell them; for when the *wind* comes from thoſe Objects, the *ſmell* of them doth more ſtrongly affect the *Organ*; whereas when it is contrary, it carries the ſaid *odorous Steams* from us, ſo as that we perceive no Scent at all.

XIV. *Dogs exceed Men in the quickneſs of Smelling.*

Many *Beaſts* excel *Men* in the ſenſe of *Smelling*; and more eſpecially *Dogs*, who not only exceed *Men*, but all other *Beaſts* in this regard.

The reaſon whereof may very probably be aſcribed to their *Organ* of *Smelling*, as abounding with very fine and ſubtil *Fibres*, and thoſe more fitly diſpoſed for the reception of *Odours*. For it is obſerved that the Olfactory *Organ* of *Dogs* is drier than that of other *Creatures*; becauſe their *Snot* doth not flow the ordinary way, but through ſome *Pores*, which may diſtinctly be perceived at the end of their Noſes. Or elſe the cauſe of this more quick Scenting that is in *Dogs*, may be attributed to their not being ſubject to thoſe groſs Fumes ariſing from the Stomachs of *Men*, who feed upon ſuch *various* ſorts of *Meat*, which hinder the reception or perception of the *ſubtil odorous* Steams proceeding from *Objects*. Hence it is that *Dogs*, that are too much converſant in *Kitchins*, and are too much fed, do by degrees loſe their Sagacity, and become much inferiour to thoſe who are kept *ſhut up*, and are only fed with *Food*, proper for hunting *Dogs*.

XV. *Why the Senſe of Smelling is weaker in Men than in Beaſts.*

Neither is there any queſtion to be made, but that if *Men* lived only upon *vegetables*, they would far excell others in this Senſe, who fare more deliciouſly, and pamper themſelves with *Fleſh* and variety of *Meats*. Thus Sir *Kenelm Digby*, in his Treatiſe of *Bodies*, relates this ſtory of one *John* of *Liege*, who fleeing into the *Woods* to avoid the violence of ſome *Soldiers*, lived there many years, feeding all the while on *Wild Apples*, *Acorns* and *Roots*; who after he had been catched by ſome Country People, after having attained the uſe of ſpeech, he declared to them, That as long as he lived in the *Woods*, he could by his ſmelling find out his *Food*, and diſtinguiſh that which was good, from that which was hurtful; that by the ſame he was aware frequently of *Hunters* that had a deſign to take him, and by this means oft eſcaped their Hands. Which Example makes it evident, that the quickneſs of the *Senſe* of *Smelling* is ſpoiled by the vapours of divers and dainty Viands; and the chief reaſon why Men are inferiour to *Beaſts* in this Senſe is, becauſe their Diet is not ſo ſimple as theirs is.

XVI. *Some Animals are ſignal for their quickneſs of Smelling.*

It may alſo be allowed, that many *Animals* do exceed *Man* in this Senſe, becauſe of the vivacity of their *Organs*; as it is evident in *Ravens*, *Vultures* and *Dogs*, which by their Sagacity purſue their Prey, or follow the footſteps of their *Maſters*: *Tigers*, who by their *ſmelling*, follow them who have taken away their *Whelps*: *Roughfooted Pigeons*, who by the ſame ſenſe, fetch back their Young, tho' carried into ſome Houſe above 200 paces diſtant from them. Neither is it any

contradiction to what is here alledged, that *Dogs* in *hunting*, are ſometimes at a loſs, becauſe this only proceeds from the great diſtance either of time or place in which the *Odour* is diffuſed, or when the odorous Steams are carried away by the *Wind*, or being mingled with other Steams produce a confuſion.

XVII. *How ſome odorous Bodies may retain their Sent for a long time.*

It is certain that *odorous Bodies* by continual expiration, become *flaggy* and are conſumed; becauſe their ſubſtance is continually waſted and diſperſed by the exhalations that proceed from them. Yet as to the great, and almoſt inconceivable ſubtilty of theſe *Fumes*, we have a very pregnant demonſtration, in a piece of *Ambergris*, which after a continual expiration of *odorous Steams* for ſeveral years together, doth to our ſenſes appear to be of the ſame Bulk. So that it may ſeem probable, that theſe *Fumes* do by a continual Circulation return to their ſource again: Much in like manner as we have ſhewed in our *Inſtitution of Philoſophy*, that the *Striate Matter* moves circularly about the *Loadſtone*; according to which *Hypotheſis* it may be made out, that an *odorous Body* may continually ſhed its exhalations without loſing ought of its ſubſtance by that means.

CHAP. VII.

Of Sound.

I. *Liquid Bodies when daſht together, make a noiſe.*

SOund doth not only proceed from *hard* and *ſolid* Bodies, but alſo from *fluid*, and which becauſe of the pliablneſs of their parts, do give way to the *motions* of other Bodies. For the *Air*, when it is ſtruck, conveys a *Sound* to our *Ears*; the *Waves* when they daſh againſt each other, cauſe a great noiſe; and all *Waters*, according as they run through a plain *Channel*, or are interrupted with *Rocks* and *Stones*, make a different impreſſion upon the *Nerves*.

The Reaſon is, becauſe the *parts* of the *Air*, as well as of other *liquid* Bodies, by their beating againſt each other, become divided into innumerable ſmall *particles*, which being moſt ſwiftly moved, and daſhing againſt each other, muſt needs produce a *Sound*. For a *Sound* is nothing elſe but a trembling and waving motion of the *Air*: And as we ſee that by the *throwing of a Stone* into the *water* many *Circles* are formed, which uniformly extend themſelves to the *Shoar* or *Banks*; ſo likewiſe the *Sound* that proceeds from Bodies that are ſtruck, is by reciprocal vibrations propagated through the *Air*.

II. *How a Sound comes to be diſperſed round.*

Which will more clearly appear in the *Figure*. Let there be ſuppoſed a String that is ſtruck, which may be conceived as a *Cylinder*, whereof the ſemiſection will make an *half Circle*, M B R, ſo as that whilſt it reſtores it ſelf, every one of its points are moved with a ſtrait motion, and by *parallel Lines*, as A B, P C, O D, N E, M F, Let us then ſuppoſe in the ſeveral points of this *Section* ſome *particles* of pure *Air*, or Moiſture, which may be conſidered as *Globuli*, or ſmall round Bodies L, K, I, H, G, *&c.* which touch the Section in the points B C D E F: Now if right *Lines* be drawn from the *Center* A, through the foreſaid points, they will terminate in the *Centers* of the *Globuli*; and if one *Globe* fall upon another, it will move the ſame by a Line joining the *Centers* of both together: So that the Arc M B, of the Section of the *Circle*, diffuſeth that moſt light matter according to the *Angle* M A B, and in like manner the *Arc* B R, according to the *Angle* B A R.

Figure 8.

III. *Why the Breath that is ſent out of our Lungs is not heard.*

Thus we obſerve that our *Breath*, when gently ſent forth from our *Lungs*, is not heard, nor when it is eaſily blown through a *Pipe*, becauſe there are none of thoſe frequent wavings, between the ſides of the *VVind-Pipe* and the Pipe, which are neceſſary to convey the ſtroaks of them to the *Organ*. In like manner, as we ſee that a *Hammer* gently applied to the *Anvil*, doth produce no ſound at all, becauſe the *Air* is not ſufficiently beaten back or undulated, as to produce that frequency of motion that may reach the *Ear*.

IV. *Why Muſical Inſtruments are commonly hollow.*

Muſical Inſtruments are commonly made *hollow*, and often approach to a *Sphærical Figure*.

The Reaſon is, becauſe the paſſing and repaſſing percuſſions of the *Air*, are multiplied in a Hollow, and therefore do the longer detain and pleaſe the *Ear*. For in *hollow* Bodies, not only the outward *Air* is agitated by frequent concuſſions, but alſo the Internal. The depth alſo of *Muſical Inſtruments* is of great uſe, becauſe then *Sounds* are the better mingled in them, and one part being agitated, doth more eaſily make the other parts partaker of the Motion.

V. *The make of the Inſtrument, and the Place, do conduce to the variety of Sounds.*

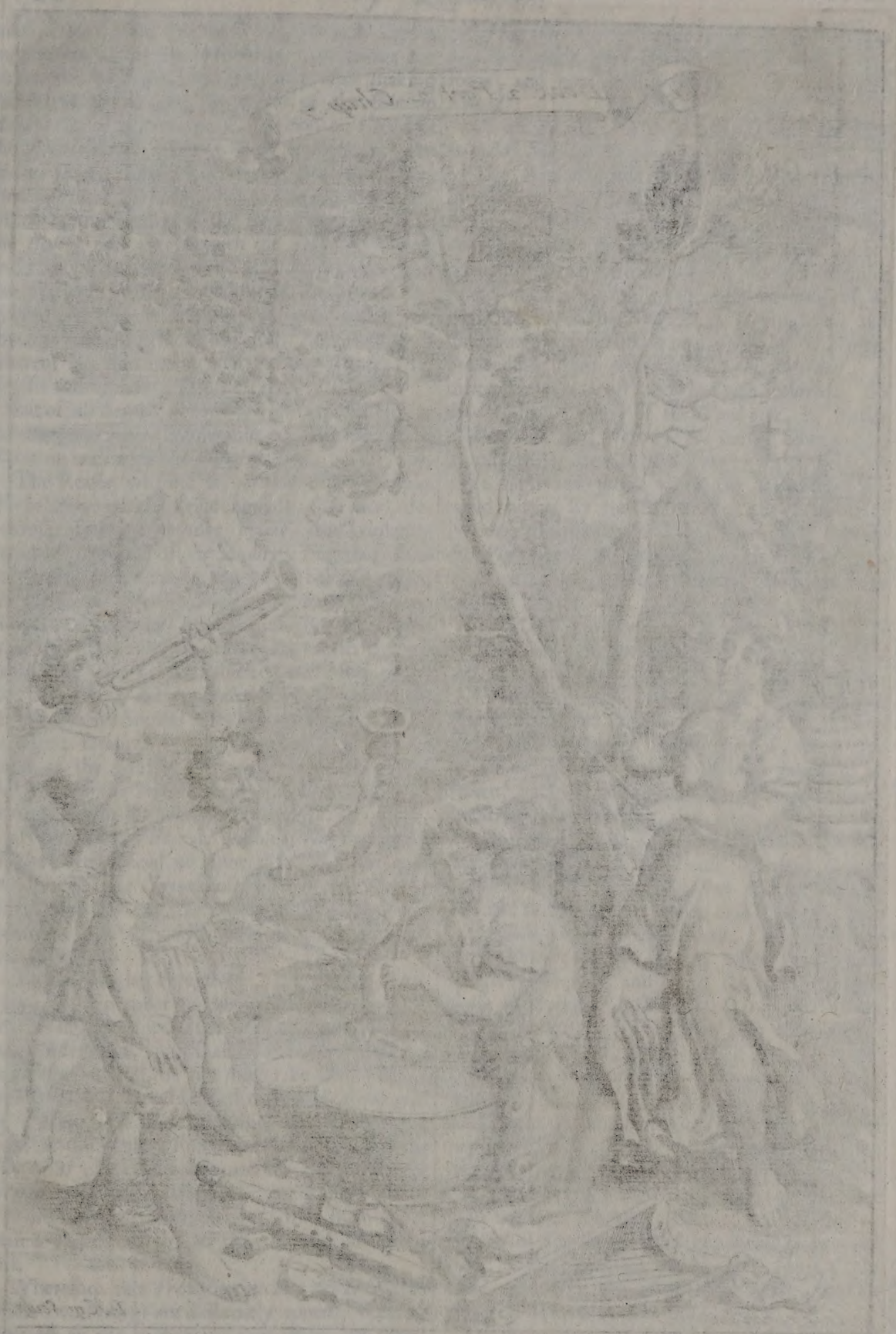
Thus *Hawk-bells*, by reaſon of the ſlit and holes they have on their ſides, do yield a greater *Sound*, than when in the open *Air* we ſtrike upon any *Braſs Veſſel*; becauſe the *Sound* of the *Bell* being pent up within the ſides of it, doth break forth whole and ſtrong. And it is for the ſame reaſon, that *Muſick* within doors in *cold weather* is more agreeable, becauſe then the *Strings* or *VVood* of the *Inſtruments* are more wrinkled, as it were, and become more *hollow* and porous. And on the other hand it is obſerved, that the *Sound* of *Muſical Inſtruments* is not ſo diſtinct in *Chambers* that are *hung*, as in thoſe that are *VVainſcotted*, becauſe the *Sound* doth more briskly rebound from a ſmooth and hard body, than from that which is ſoft and yielding. For indeed all ſoft Bodies are leſs fit for the generation of *Sounds*, and do eaſily tranſmit them. And it is for the ſame Reaſon, that the *Sound* of *hot Iron* is more dull, than that which is cold, even becauſe it is more ſoft, and the parts of this latter do yield more frequent vibrations.

VI. *What is the Reaſon that a Deaf Man can perceive the Sound of a Lute, whilſt he holds his Teeth upon the Neck of it.*

A perſon that is *Deaf* may perceive the *Sound* of a *Lute*, or any other *Inſtrument*, whilſt he holds the Neck of it between his *Teeth*.

Some have conceived that this is to be attributed to ſome conveyances, reaching from the *Mouth* to the *Ears*, which carry the *Sound* thither, and impreſs the ſame affection upon them, which is tranſmitted by the *Organ* of *Hearing*. But that this is not ſo, is apparent, becauſe the ſame effect doth not follow when we hold our *Mouth* open. Beſides, if this were ſufficient, why might not ſounds be perceived by the touch of the *Forehead* or *Noſe*; ſeeing that from theſe parts there be paſſages to the *Ears*, and an equal communication between them?

Conclude we therefore, that the *Sound of a Lute* can therefore be heard or perceived by thoſe who hold the Neck of it between their *Teeth*, becauſe the vibrations of the *Strings* being tranſmitted



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mitted from the *Lute* to the *Teeth*, are from thence communicated to the *Membran* that covers the *ſockets* of the *Teeth*, and preſently after ſhaking the *Drum* of the *Ear*, by means of the ſhut up *Air*, do alſo agitate the Connexion or Chain of the 3 *little Bones*. For a *Body* is then properly ſaid to yield a *ſound*, when being ſtruck, it performs ſeveral *Vibrations* by a tremulous motion, which by the Vehicle of the *Air* is diffuſed through the *Bodies* that are between the *ſounding Object* and the *Organ*. For there is a conſent betwixt the *Nerves*, which are diſperſt throughout the inward parts of the *Mouth*, and thoſe which run through the *Muſcles* of the *Ear*. An Argument whereof is, that harſh and grating *Sounds*, do ſtupifie and ſignally afflict the *Teeth*.

VII. *Why a grating, ſkreaking Noiſe is very offenſive to the Ears.*

But of all *Sounds*, none are more ungrateful to the *Ear*, and indeed intolerable, than the ſkreaking Noiſe of a *Saw*, or the *filing* of *Iron*.

The Reaſon whereof is, becauſe the *particles of the Air*, which ſtrike againſt the *Ear*, do, becauſe of their irregular *figure*, too violently vellicate the *fibres* of the *Auditory Nerves*, ſo as that thereby they are in danger of being broken, and ſometimes break actually, whence that troubleſom and painful Senſation doth ariſe. The ſame alſo, tho' in a leſs degree, is cauſed by the hearing of falſe *Tones*, which is extreamly offenſive to a *Muſical Ear*. And accordingly, by means of the foreſaid Sounds the *Teeth* are ſometimes ſet on edge; foraſmuch as by this inordinate undulation of the *Air*, the *Nervous fibres* which are at the Root of the *Teeth*, are in a manner looſed and ſeparated from their former ſtability.

VIII. *What is the Reaſon why, when the one of two Uniſon Strings are ſtruck, the other trembles.*

If 2 *Lutes* or *Citterns*, whoſe *ſtrings* are made *Uniſon*, are placed at ſome diſtance from each other, when the *ſtrings* of the one are ſmartly ſtruck, thoſe of the other tremble alſo, and that ſo ſtrongly, that they will ſhake off a bit of *Paper* laid upon them.

The Reaſon is, becauſe the *ſtring* being ſtruck by a certain number of *Vibrations*, ſhakes the *Air*, which lighting upon the *Uniſon ſtrings* of the other *Inſtrument*, doth ſhake it likewiſe. And this more eſpecially, if the ſaid *ſtrings* be conſonant in an *Eighth* or *Fifth*, for then their *Vibrations* will be leſs confuſed, and agree in their certain and frequent Intervals. For in an *Eighth*, all the *Vibrations* of a more lax and longer Chord or *String*, agree with a *Second*, *Fourth* and *Fifth* of a more ſtretched and ſhorter Chord; in a *Fifth*, with a *Third*, *Sixth* and *Ninth*, and ſo of the reſt.

Wherefore this *Trembling motion* never follows where two *Strings* are differently tuned: Whereas *Concords* do not only excite each other, but others alſo, by reaſon of the ſimilitude of their *motions*, and do ſo aſſiſt each other, as mutually to impart the ſame Affections. As may be experienced in any *Muſical Inſtrument*.

IX. *Whether there be ſuch a thing as white Gunpowder, whereby Guns may be diſcharged without Noiſe.*

It is a common Report amongſt the *many*, that there is a *White Gunpowder*, with which *Guns* may be diſcharged without giving any *Report*.

This, tho' very confidently aſſerted, appears to be a meer figment. For it is impoſſible that the pent up *Air* ſhould be able to break forth without making a Noiſe: For that which is of ſuch a force as to be able to drive a *Bullet* with as great ſwiftneſs, as the Flame breaks forth from the *Gunpowder*, muſt needs ſtrike the *Air* with a like force, and conſequently produce an anſwerable *Sound*.

Of all *Animals*, *Men* and *Birds* only are able to make *Muſical Sounds*.

X. *Why Men and Birds only can give forth Muſical Sounds.*

The Reaſon hereof muſt be fetch'd from the ſtructure of the *Throat* and *Wind-pipe*, the *Rings* whereof in *Men* and *Birds* are capable of being contracted and extended. For there is a double recurring *Nerve* in the *Wind-pipe*, which turning round about it, doth by the help of ſome of its Branches move the *Rings* of it downwards; and foraſmuch as the ſame is terminated in the *Nerve*, proceeding from the *Plexus Ganglioformis*, it moves the folds of the *Wind-pipe* upwards. So that whilſt the *Rings* of the *Wind-pipe*, by means of the recurrent *Nerve*, are moved downwards, it cauſeth a *deep* or *baſs Tone*; which becomes more high and *ſhrill*, when the ſaid *Rings* are raiſed higher by the Branches of the *6th pair* of *Nerves*, diſſeminated in the *Wind-pipe*; becauſe the *Wine-pipe* being ſtraitned by this means, doth in a manner break the *Sound* that paſſeth through it.

XI. *The Smoak of a Candle, is agitated by the motion of the Strings of a Muſical Inſtrument.*

If a *Lute* be play'd upon near a *Smoaking-Candle*, the ſame motion of the *Strings* will be communicated to the *Smoak*.

The Reaſon hereof is, becauſe the trembling Vibrations of the *Strings* do move the fluctuating *Air*, by the reiterated onſets whereof, the *Flame* (which of it ſelf is very moveable) begins to be ſhaken, and to conform it ſelf to the motions of the *Strings*. Hence it is, that when a *Ray* of the *Sun* is let in into a *dark Room*, and a *Muſical Inſtrument* be plaid upon near the ſaid *Ray* or *Sun-beam*, the Motes in the *Sun* will be ſeen to leap and skip in the *Air*, and, as it were, to dance to the *Muſick* of the *Inſtrument*. The ſame may be alſo obſerved in the *Water*, when the *Surface* of it is very ſmooth and even; for then upon the Noiſe of *ſtringed Inſtruments*, it will become ruffled and curled. The ſame alſo may be obſerved in 2 *Glaſſes*, into which if we put *water* to the height of 1 or 2 *Fingers* breadth, and bring them to an *Uniſon*, (which may be eaſily done by the *Ear*, in drawing our *Finger* round the Edge of them;) for then, if we fix a *Crooked-Pin* upon the Brim of one of the *Glaſſes*, we ſhall ſee it move and skip, as we preſs the Brim of the other *Glaſs* with our *Fingers*.

XII. *Tones, or Muſical Sounds, are not ſo proper to cauſe ſleep, as ſome other Natural ſounds.*

Muſical Sounds are not ſo conducive to provoke *Sleep*; as the Humming of *Bees*, the *Noiſe of the Wind*, the *Murmur of Running-water*, and an equal and ſmooth Tone of *Reading*.

For ſeeing that the *Sound* is diffuſed from the Sonorous *Body* to the *Drum* of the *Ear*, and from thence to the *Acouſtick Nerve*, and ſo to the *Brain*, the Center of the *Nerves*, and laſt of all from thence to the *Arteries*, *Veins* and *Guts*, it cannot be but that the *Blood* and the *Spirits* muſt be moved alſo: And becauſe *Muſical Sounds* are not carried with an Equal Courſe, nor do paſs by the *Ears*, they do affect the Senſe of *Hearing* more than other *Sounds*, and more awake the Attention, which is the reaſon that they are not ſo fit for the provoking of *Sleep*.

Long

XIII. *Musick corrupts Manners.*

Long Experience hath taught, that ſoft and Effeminate ſtrains of *Muſick*, are very proper to corrupt the Manners of *men:* Whereas, on the other hand, the Sound of *Cornet*, *Trumpets* and *Drums*, do fill Men with a Couragious and *War like Spirit*.

For ſeeing that *Human Affections* are nothing but *Senſations*, produced by the motion of the *Spirits*, we need not wonder that the *Sound* arriving at thoſe *Veſſels* in which the *Paſſions* are generated, ſhould produce various *Paſſions*. And foraſmuch as the *Manners* of Men commonly follow their *Paſſions*, it is evident that *Sounds* muſt needs be of great uſe, either for the corrupting or correcting of Mens *Manners*. Accordingly PLATO was of Opinion, that all ſoft *Tunes* ought to be baniſhed out of a well-governed City. And the *Lacedæmonians* aſſign'd a great Puniſhment to thoſe that uſed any ſoft or effeminate kind of *Muſick*; and made a *Law*, that none ſhould play upon a *Harp* that had above 7 *ſtrings*.

XIV. *Why upon the ſtopping of our Ear, we hear a kind of humming Noiſe.*

When we ſtop our *Ear* with our *Finger*, we ſuddenly hear a buzzing kind of *Noiſe*.

Becauſe it is owned by *Phyſicians*, that a Steam or *Vapour*, doth proceed out of the Hollow-winding of the *Ear*; ſo that when the *Ear* is ſtopt, this pent up *Steam*, as well as the *Air*, ſeeking to get out, do beat and diſtend the *Drum* of the *Ear*; from which Motion, an Affection is produced like to a great *Buzzing*. Yea, it is frequently found, that the *Ears*, tho' not ſtopt by our *Finger*, are fill'd with this *Buzzing Noiſe*, produced by the blaſt of a moſt thin Steam or *Vapour* breaking forth from ſome little *Artery* or *Vein*, which ſtriking againſt the *Drum* of the *Ear*, affects it much in the ſame manner, as it would be by the *ſound* of a *Bell*.

XV. *Sound more eaſily paſſeth through a Beam of Wood, than through the Air.*

A *Sound* is more eaſily diffuſed through the length of a *Beam*, ſtruck at one end, than through the *Air* only. For as ſoon as one end of the *Beam* is moved, in the ſame inſtant the motion is communicated to the other.

The Reaſon is, becauſe there is a greater *Continuity* of Parts in the *Beam*, than in the *Air*. For, when you move one end of the *Beam* A, at the ſame time the other B is moved alſo; but if you puſh the *Air* at C, it muſt at leaſt move as far as D, before it can move E; becauſe all its parts give way like a *Sponge*; and becauſe it takes up Figure 9. ſome time in paſſing from C to D, it loſeth alſo part of its Force. Whence it comes to paſs, that the *Sound*, which is nothing elſe but a motion of the *Air*, is both ſooner and more ſtrongly heard at the Point D, than at the Point E.

XVI. *Why Sounds are more clearly and diſtinctly heard near the Banks of Rivers.*

Which is the Reaſon why the *ſounds* of *Great Guns* and *Bells*, are more diſtinctly perceived along the *Banks* of *Rivers*, than when we are at a diſtance from them; and it is univerſally true, that all and every *ſound* is both ſooner, and at a greater diſtance, communicated by *water*; for the parts of the *water* being more cloſe and ſtiff than thoſe of the *Air*, when once put in motion, do communicate their Force to others. To this moreover may be added, the ſmooth *ſurface* of the *water*, which doth not in the leaſt break or turn aſide the *ſound*. Thus by laying our *Ear* to the ground, we can perceive the trampling of *Horſes* at a great diſtance; and if a *Drum* be ſet upon the *Ground*, and the *Ear* laid to the upper Skin of it, the Noiſe of the marching of *Horſes* can be perceived at ſome Miles diſtance.

XVII. *How the Voice of one man comes to be diffuſed to the Ears of ſo many.*

The *Voice* of a *Preacher* in a *Church*, or *Actor* upon a *Stage*, reacheth the *Ears* of ſome Thouſands of his *Hearers*.

This is not, becauſe the *whole* Voice of one *man* comes to the *Ears* of all that hear him; for the *Voice*, as ſoon as it comes forth out of the *Mouth*, is broken into many parcels all like the whole; much in like manner as when *Fullers* ſpout out *water* out of their *Mouths*; for then the *water* is diſperſed into innumerable drops, and fills a very large ſpace. From the Mouth of the *Speaker* an entire Voice doth indeed proceed; but is afterwards divided into innumerable *Voices*: And therefore ſure it is, that no two *Auditors* receive the *ſame* Voice, tho' they be ſaid to hear the ſame, becauſe of the likeneſs of theſe divided *partial Voices*, with the entire or total *Voice*. In the ſame ſenſe, as they are ſaid to drink the ſame *Liquor*, who drink out of the ſame *Fountain*.

XVIII. *Sounds are diffuſed along ſome certain Tract or Currents, more than others.*

Tho' Experience ſhews, that the whole *Atmoſphere* of the *ſonorous Body*, is moved to ſuch a proportionate Circumference; yet is not the ſaid fluctuation of the *Air* equally diffuſed through all parts of the *Air*, but the *ſound* ſeems rather to be carried along ſome certain Tracts or Currents. And therefore it is that the Words of a *Preacher* or *Orator*, tho' they move the whole *Atmoſphere* of the *Auditory*; yet it agitates that Tract moſt which his *Mouth* more directly anſwers to, where the *Auditors* do alſo more diſtinctly *hear* his *Voice*, than thoſe who are more remote from that Tract. Thus it is well known, that theſe only hear the *hiſſing Noiſe* of a *Bullet*, diſcharg'd from a *Muſquet*, who are near to the Line deſcribed by the *Bullet*, whilſt thoſe who are at ſome diſtance perceive nothing of it.

XIX. *Sounds are equally diffuſed.*

Sounds that are excited in any one place, be they Loud or Low, are in equal time conveighed to the place, where they are *heard*.

The Reaſon is, becauſe the *Air* being a *Continuous Body*, when ſtruck, is formed into *Orbs* or *Circles*: As we ſee that *ſtill-water*, when a *Stone* is caſt into it, becomes waved into *Circles*; and as the ſaid *Circles*, at an Equal diſtance, ſpread themſelves to the *Banks*, whether they be cauſed by a little or great *Stone*; ſo likewiſe doth the *ſound*, at an equal diſtance of Time, come to the *Ear*, whether it proceed from a great *Gun*, or a *Muſquet*, or any other thing.

XX. *Whence it is that a double Sound is perceived from the ſtriking of one String.*

It ſometimes happens, that 2 *Sounds* are heard, when one only *ſtring* is ſtruck.

This proceeds from ſome *defect* in the *ſtring*, which when they are falſe and uneven do admit 2 ſeveral kind of *ſhakings* at one and the ſame time, whereof the *one*, and which gives the deeper *ſound*, proceeds from the whole *ſtring*; the other, which affords a more ſhrill *ſound*, depends on the unevenneſs of the *ſtring*. Suppoſe, for Example, that when the *ſtring* A B is ſtruck, as often as it paſſeth and repaſſeth from 1 to 6, to produce its *Natural ſound*, at the ſame time the Unevenneſs of its parts produce another *ſhaking* in it, by means whereof, when it hath moved from 1 to 2, it runs back to 3, and from thence towards 4, and from 4 to 5, and laſtly to 6, which produceth a *ſound* that is by a *Twelfth* more ſhrill than the former: Figure 10.

former: In like manner, if the *ſecond* ſhaking be only double to the former, it will yield an *Eighth*; if Quadruple, a *Fifth*; and if Quintuple, a *Seventeenth* more than before.

XXI. *Why we ſee the Lightning before we hear the Thunder.*

A *Sound* takes more time to arrive at our *Ears*, than the *Light* to come to our *Eyes*; which is the Reaſon why we perceive the *Lightning* before we hear the *Thunder*; and we ſee the *Ax* of one that hews *Timber*, when we are at ſome conſiderable diſtance, lifted up to make a ſecond ſtroke, before we hear the firſt.

The Cauſe whereof is the *Air*, which altho' it conſiſt of *ſubtil parts*, and divided from each other; yet being withal Branchy and *flexible*, when one of them is moved, the other parts are not preſently moved at the ſame inſtance, but by degrees; ſo as that one part being agitated, puſheth on the next, and ſo on; like the *Circles in the Water*, which do not in an inſtant ſpread themſelves over the whole *ſurface* of it, but proceed in a continual order till they come to the *Banks* of the *River*, or that they ceaſe upon the failing of the force, which cauſed them at firſt. But *Light* is much more ſwiftly conveighed to our *Eyes*, as being cauſed by inflexible and ſolid *Globuli*. For it is the Nature of *ſolid Bodies*, that when one end of them is preſt upon, the ſaid preſſion is felt at the ſame moment of time, at the other end of it. Whence it is that, as was ſaid before, a *Sound* is ſooner conveighed through a whole *Beam*, than through the *Air*; becauſe the *parts* of the *Beam* are more cloſely joyned together, than the *parts* of the *Air*, which are flexible, and eaſily give way to other *Bodies*.

XXII. *Strings of an unequal length, yield a different ſound.*

Let there be 2 *Strings* of the ſame thickneſs, and wound-up at the ſame height, whereof the one is longer than the other; that which is the ſhorter of the two will yeild the ſhrilleſt, or moſt treble *ſound*; and the longer, the deeper *ſound* and leſs perceptible.

This difference of the *Sound* proceeds from the more frequent, or fewer *Vibrations* of the ſaid *ſtrings*: For ſeeing that a *ſhorter String* makes more wavings, and beats the *Air* with more reiterated ſtroaks, by ſo much ſhriller is its *ſound*, and the ſooner it conveighs the *ſound* to the *Ear*. Becauſe the difference of a deep and ſhrill *ſound*, doth not proceed from the more ſwift or ſlow motion of a *ſtring*, as ARISTOTLE was of Opinion, but from the variety of the *Vibrations*, which, if they be frequent, produce a treble or ſhrill *ſound*; but if fewer, are the cauſe of a deep or baſs *ſound*.

In like manner we may give an account, why the leſſer of 2 *ſtrings* that are wound-up alike, but of different length, makes its *Vibrations* more ſwiftly. The Reaſon is, becauſe tho' both the *ſtrings* make their Excurſions with an Equal motion, with reſpect to Space and Time; yet becauſe the leſſer, by its motion of Contraction, runs through a leſs ſpace than the *longer*; and that a leſs Space is ſooner run through with an Equal motion than a Greater, it muſt needs be that the motion of the Leſſer Cord be ſwifter.

XXIII. *Why the Sound ceaſeth upon touching the Strings*

Whence it is evident, that if you lay your Finger upon a String preſently after you have ſtruck it, before it have made many of its *Vibrations*, you will indeed hear ſome kind of Noiſe, but without being able to diſtinguiſh whether it be *ſhrill* or *deep*, becauſe your *Finger* hinders the *Vibrations*, and doth not ſuffer the *ſtring* by its preſſion to dilate the *Air*, and to drive it away by a ſucceſſive beating of it. Hence it is that a ſlow and ſoft blaſt, blown into a *Pipe*, produceth no *ſound*, nor that which from the *Lungs* is breathed out by the *Mouth*; becauſe there is no rebounding of the *Air*, between the ſides of a *Pipe*, nor in the *Wind-pipe* or *Mouth* of an *Animal*, which bounding this way and that way, is the cauſe of a *ſound*; and according as their Repetitions are more ſwift or ſlow, ſo they produce either a *ſhrill* or *deep ſound*. *with ones Finger.*

XXIV. *Why the Eccho repeats the ſame Voice ſeveral times.*

An *Eccho* doth frequently repeat the ſame *Voice*, and renders the ſame *ſound* at diſtinct Intervals. So CLAUDIAN makes mention of one that rendred the *Voice* no leſs than 7 times: And GASSENDUS tells us, that he had Experienced, that in the *Chapel* of *Charenton*, which is about 3 or 4 Miles diſtant from *Paris*, one *Syllable* pronounced at either end of it, was repeated 17 times, and that the ſame word ſpoken in the midſt of it, was as many times repeated from both Sides.

The Cauſe of this is, the Reflection of the *Sound* from ſome interpoſed let or hindrance: For as innumerable Rays are conveighed from the viſible Object, not only to the *Eye*, but every way round; ſo beſides the *Voice* which is carried to the *Ear*, innumerable other *ſounds* are diſperſed in the *Air*, which meeting with hard and concave *Bodies*, are diſperſed through the *Air*, which makes the ſame *Voice* to rebound ſeveral times. For *Sound* is not conveighed like the *Light*, in one moment, but ſtands in need of time, to propagate it ſelf: And therefore when the former *ſound* becomes extinct, or vaniſheth in the neighbouring *Air*, another is generated in that which is farther off; which being reflected from ſolid and tolerably ſmooth *Bodies*, doth frequently beat the *Air* that is nearer the *Ear*. A *Sound* therefore is oftentimes repeated by the *Eccho* in the *Chapel* at *Charenton*; becauſe the place there is ſo diſpoſed, that the nearer places do firſt repeat the *Voices*, and the more diſtant afterwards. It conduceth alſo to the forming of an *Eccho*, that the *Bodies* which reflect the *Sound* be oppoſite to each other, and ſend back the ſame by turns; as it was in the *Chapel* at *Charenton*, before that the *Monaſtery* of the *Carmelites* was built there: For at that time there was a double Row of *Pillars*, between which the uttered *Voice* was rebounded; much like a *Ball*, which lighting againſt one *Wall*, rebounds thence to the other.

XXV. *Why the Eccho is heard only in one part.*

Tho' the *Eccho* be a *Sound* which is every way circularly extended, yet can it only be heard in one part of the *Circle*; becauſe it can only be received from the Reflexion of that *part* of the *Circles*, which is the fartheſt extended, and in that part where the ſaid *Reflexion* is made. As we obſerve, that when a *Stone* is caſt into a *River*, the *Circles* which are there formed; are further extended towards that part, where the *Stone* was caſt in, than towards the oppoſite.

XXVI. *A reflected Sound is of longer continuance, than one that is not reflected.*

A *Sound* that hath been frequently *rebounded*, is preſerved or continued a longer time, than that which without repercuſſion is propagated in a Right line.

The Reaſon is, becauſe by the ſeveral *Bodies* and Cavities againſt which the Repercuſſion is made;

made, the *ſound* is ſtrengthned and increaſed, and therefore is longer a vaniſhing, than if it were only extended in a Strait line, without repercuſſion. Moreover, it is evident from the Obſervations of many, that in the *Village* of *Simonetta*, about a mile diſtant from *Milan*, the *Voice* is often repeated 30 times, and in every one of its paſſings and repaſſings, it runs through 156 Paces and upwards; whence it follows, that the ſame *Voice*, being ſeparated 32 times, before it be altogether extinguiſht, muſt run through 5002 Paces and upward. From whence it may be eaſily gathered, that the *ſound* muſt needs be greatly increaſed in the ſaid Concamerations, by means whereof it is enabled to continue ſo long, ſeeing it doth not ſeem poſſible, that by continual direct Motion, a *ſound* ſhould be able to reach 5 *Miles*, in which motion of the *ſound* 25 *Horary minutes* muſt be ſpent.

XXVII. *A Sound is hindred by the Interpoſition of a ſolid Body.*

When a Man *ſpeaks* to another, a thick *Glaſs Window* being between them, his *Voice* will ſcarcely be heard; but if there be only a *Paper Window* between them, the *Voice* may be well enough diſcerned.

The Reaſon is, becauſe the *ſound* is an effect of the *motion* of the *Air*, and therefore becauſe little or no *Air* can paſs through the *pores* of the *Glaſs*, the *Organ* of *Hearing* cannot be affected thereby. Foraſmuch as the intervening *Glaſs* is ſuppoſed to be ſo firm, that it is not capable of being ſhaken by the *ſound*; whereas the *Air* eaſily paſſeth through the *pores* of *Paper*, eſpecially if the ſame be ſtretched, becauſe by this means it is the more eaſily ſhaken, and its *pores* are made more lax and open.

XXVIII. *A Bell, when ſtruck on the upper part of it, yields a ſhriller ſound, than when hit lower.*

A *Bell* yields a more ſhrill *ſound* when ſtruck on the upper part of it, than when it is hit Lower.

The Reaſon is, becauſe the hollowneſs conduceth to the *Deepneſs* of a *ſound*; and becauſe the further that the *ſound* is propagated the more Baſs or deep it is. Thus the lower Holes of a *Recorder* afford a deeper *ſound*; for the ſlower the beating of the *Air* is, the deeper is the *ſound*. As we find that the more *water* there is in a *Glaſs*, when we preſs our *Finger* round the Edge of it, the more ſhrill the *ſound* is, for then the Vibration of the *Air* is the ſwifter, as when leſs *water* is in the *Glaſs*, ſo much the more deep the *ſound* is.

XXIX. *How it comes to paſs, that Glaſs may be broken by a Voice or ſound.*

It is obſerved, that a *Drinking Glaſs* may be broken by a man's *Voice* only, and that by reaſon of the repeated *Vibrations* of the parts of a more ſolid *Body*. For the effecting whereof, *firſt*, we muſt try by a ſtroak with our *Finger*, what Tone the parts of the *Glaſs* do yield, and then muſt ſet our *Voice* as near as we can to the ſame Tone, and increaſe the ſame by degrees, till we come beyond a *Diapazon* or *Eighth*: Whereupon the inſenſible parts of the *Glaſs* being ſtruck with iterated ſtroaks, become agitated by a tremulous motion, which increaſeth as they are ſtruck in fit places, ſo that at laſt, by the augmentation of the force of the *ſound*, the parts of the *Glaſs* leap aſunder. But for this Experiment, a ſmooth and even *Glaſs* muſt be made choice of, and ſuch as when filipt with the *Finger* doth not *ſound* ſo ſhrill, but that the *Voice* of him that ſings, may equal it, or go beyond it.

XXX. *Why a Sound can ſometimes be better heard by one that is at a diſtance, than by him that is nearer.*

Sir KENELM DIGBY relates in his *Treatiſe of Bodies*, that he had ſeen the *Walls* of a large and round *Tower* (tho' I rather ſuppoſe it to have been of an *Elliptical figure*) which were ſo Artificially built, that 2 *men* ſtanding at the oppoſite points of the *Diameter*, might eaſily and diſtinctly talk together, whilſt thoſe that ſtood in the midſt, could not perceive the *leaſt* of any thing that was ſpoken.

The Reaſon of this muſt be fetched from the *Coition* or meeting of all the *ſounds*, which are diſperſed through the whole Room: For ſeeing that all the *Air* in the Room is ſhaken by the uttered *Voice*, the motions thereof being diffuſed through that large Space, are reflected from the *Wall* of an *Elliptical figure*, and ſo by *Reflexion* become united in the uttermoſt part of the *Chamber*; and therefore he that lays his *Ear*, muſt needs hear the *Voice* of him that ſpeaks at the other end, tho' with a very Low *Voice*.

XXXI. *How a Sound becomes increaſed by the means of a Pipe.*

Upon the ſame account it is, that by means of a *Pipe*, contracted in manner of a *Cone*, *ſounds* may be increaſed, and made to be *heard* further off, better than nearer hand; and this, becauſe the *ſound* is increaſed proportionably, as the *Tube* is contracted; for by this means the *ſound* muſt needs be increaſed in its paſſage through the *Pipe*. And accordingly they who are *Deaf*, make uſe of a *Horn*, whereof the one end is wider than the other, which they apply to their *Ear*, by it to receive the *Voice* of him that ſpeaks to them. And by this means, a *Prince* might eaſily hear the *Voices* of thoſe that walk in his *Garden*, by having *Pipes* conveyed from thence to his *Cloſet*, the wideſt Mouths of them being ſet outward, and the narroweſt inward.

XXXII. *How a Sound comes to be propagated at that great diſtance by the* Stenterophonick Tube.

The *Stenterophonick Tube*, ſometime ſince Invented by Sir SAMUEL MORELAND, which carries the *Voice* to the diſtance of a Mile or two; and that other *Trumpet*, which ALEXANDER *the Great* made uſe of, in giving Orders to his *Army*; whereof the Figure is to be ſeen in an Ancient *Manuſcript* of the *Vatican Library*, are made after another manner; for they are ſtreight or narrow at the *Mouth*, to the end that the *particles*, which are to make the *Reflexion*, being cloſe together, may be the more eaſily beaten, and from thence the *Trumpet* grows wider and wider to the very end of it, in order to augment the agitation of the *Air*, by the multiplication of all the *Reflexions* which are made throughout the whole length thereof; yet with this Circumſtance, that the Bore of the *Pipe* might be ſo great, and the *Trumpet* ſo long, that the *ſound* would be no longer increaſed, becauſe the *Reflexions* would become ſo weak, as not to be longer in a condition to move the *particles* of the *Trumpet*, and conſequently cauſe a new *Reflexion*.

XXXIII. *Why Bees, when they ſwarm, are recall'd by making of a Noiſe.*

Swarming Bees are recalled by beating upon *Frying-pans* and *Sithes*.

Some ſuppoſe the cauſe hereof to be, becauſe Bees are delighted with theſe *Noiſes*, and being thereby allured, do all unite themſelves in one great hanging Bunch or Cluſter. But this is not at all probable, becauſe when the Bees are got up into any height of the *Air*, how much ſoever the ſaid Inſtruments may be beaten, this will not bring them down, or hinder them from flying away.

Where-

Wherefore the true Cauſe hereof ſeems to be, becauſe the *Air* being much ſhaken, and agitated with the *Sound*, the Bees not being able to bear the ſame, are forced to unite themſelves and ſettle in a heap. For Bees have very thin *VVings*, not feathered ones like *Birds*, but conſiſting of a thin *Skin*; by means whereof they cannot endure this concuſſion of the *Air*: Which probably alſo is the reaſon, why they never leave their *Hives* when there is a great *VVind*, or at *Midnight*, but only in calm and hot *weather*.

CHAP. VIII.

Of Light.

I. *Light may be excited without a Luminous Body.*

UPON the rubbing of our *Eye*, tho' it be ſhut, there appears a round *ſpot* of *Light*, and the ſame will be by ſo much clearer, the nearer the rubbed part of the *Eye*, is to the bottom of it.

This is an *Argument* that *Light* doth not exiſt without the *Eye*, but is only in the *Eye* of him that *ſees*; and conſequently that the *Bodies*, which are commonly called *Luminous*, are only ſaid to be ſuch Potentially; that is, in caſe they ſtrike the *Eye* of the *Seer*: So that if there were no living *Creatures* in the World, which could *ſee* the *Light*, neither could any *Light* properly be ſaid to be in it. And therefore we muſt conclude, that *Light* is not in the *things* which are called *Bright* or *Luminous*, but in him that perceives it; in like manner, as *Pain* is not in the *Sword*, but in him that feels it.

II. *Why the Rays of Light, by paſſing through a narrow hole, do croſs each other.*

The *Light* paſſing through a ſmall *hole* into a *Dark Room*, enters the ſame croſs-wiſe.

The Reaſon is, becauſe the *Rays* flow from each point of the *Lucid Body*, in *Right Lines*: Wherefore becauſe the *Object*, without the *hole*, is bigger than it, it is impoſſible the *Rays* ſhould paſs through it, without croſſing each other; and by this means it comes to paſs, that the *ſituation* of the whole *Lucid Body* is repreſented upſide-down, on an *Opake Body*.

III. *Light paſſing through the holes of two Walls, is not perceived by thoſe who are in the Room.*

Let a *hole* be made in one of the *VValls* of a *Room* of that bigneſs as may admit the flame of a *Torch* or *Candle*; and juſt over-againſt the ſaid *hole*, let another more large be made in the oppoſit *VVall*; then in the *Night* let the *Flame* of a *Candle* be held on the outſide of the leſs *hole*, ſo as that the *Rays* that paſs through it, may be admitted by the oppoſit *hole*, and paſs through it alſo; by which means the whole *Chamber* will continue dark, as if no *Rays* at all were tranſmitted through it.

The Reaſon of this *Experiment* is, becauſe *none* of the *Rays* that paſs through the *Chamber*, do reach the *Eye*, nor affect it; and yet muſt, before any *viſion* can follow. And for the ſame Reaſon it is, that thoſe who in a clear *Night* lift up their *Eyes* on high, perceive all ſpaces above the *Horizon* to be equally covered with Darkneſs; when as yet thoſe immenſe *Spaces*, except only that part of them which is vail'd by the *Cone* of the *Earths Shadow*, are no leſs guilded by the *Sun*, than they were at *Noon-day*. And this becauſe the *Rays* which are diffuſed through thoſe immenſe *Spaces*, cannot reach our *Organs*, nor produce any motion in them.

From which Experiment it is evident, that the *Light* depends on the *Eye*; ſo that if there were no *Eye*, or no *Eye* open, neither could there be any *Light*, or *Brightneſs*, ſuch as we perceive when we lift up our *Eyes* to *Heaven*, and behold this moſt beautiful appearance of *things*.

IV. *There can be no Light without the Eye.*

A *Spark* of *Fire* ſheds its *Light* through a very large ſpace. For a *Spark* of *Fire*, without any *Proſpective Glaſs*, may be perceived in the *Night*, at the diſtance of 500 paces; and with a *Proſpective* may be diſcerned at the diſtance of 50 Leagues, and probably much farther.

V. *A Spark of Fire, by means of a Proſpective may be perceived at 50 Leagues diſtance.*

It ſeems ſtrange to ſome, that ſuch a *ſmall Lucid Body* ſhould be of ſo great a force, as to puſh the intervening matter of the Second *Element* in a *Right Line*. But this their wonder will ceaſe, if they conſider that this *ſubtil matter*, which is diffuſed through the *Pores* of *Diaphanous Bodies*, is like a moſt *Fluid Liquor*, whereof one part cannot be preſt upon, but that all the part muſt be moved by it. As for Example, let there be a double *Tube* or *Pipe*, A B C, filled with *water*, and of a length as great as you pleaſe; if whilſt the *water* is at reſt, and deſtitute of all *motion*, you put a *drop* of *water* into one of the ends, *viz.* A, no *Body* will deny but that the *weight* of that one *drop* will be ſufficient to *raiſe* the *water* towards the other end C, and conſequently to put the whole maſs of *water* contained in the ſaid *Pipe*, A B C into motion. Figure 11.

And for the ſame Reaſon, who will not acknowledge that a *Spark* of *Fire* may be ſufficient to agitate the *Heavenly Matter*, diffuſed through a large ſpace of *Air*? Foraſmuch as the action of *Fire* doth far ſurpaſs the force of *Gravity*; as alſo becauſe the *ſubtil matter* which is contained within the *pores* of the *Air*, and of the *Water* too, is more fluid than either of them. Wherefore it is evident, that the flame of a *Candle*, muſt needs move the *ſubtil matter* that is contain'd in the round of 50 leagues *Diameter*; foraſmuch as by the force of its *motion* it puſheth the circumambient *Air*, much in the ſame manner, as a *Stone* that is whirl'd round in a *Sling*, preſſeth down the bottom of it; and by the vertue of its *Circular motion*, doth extend the String of it in a ſtraight Line. For the *ſubtil matter*, which on every ſide ſurrounds the *Spark*, is alſo turned round, and ſtrives to withdraw from that place.

VI. *How it comes to paſs, that the Rays of Light do not hinder one another.*

But from this Explication of *Light*, no ſmall Difficulty ſeems to ariſe, *viz.* how it comes to paſs, that the *Spark* which puſheth the *ſubtil matter* contained in the *Pores* of the *Air* to *Right Lines*, can be perceived, when another of the ſame force and virtue is oppoſed to it. For let us ſuppoſe ſome one *Globule* of the *Air* A B C D, whoſe *Center* is E; and at A and B, 2 *Lucid Bodies* of the ſame force, it will follow, that either the ſaid *Lucid Bodies* will not be perceived from the oppoſit places C and D, which is contrary to *Experience*; or that the *ſubtil matter* in the *Center* E, will be in many places at once, which is repugnant to the nature of *Bodies*. Which may be thus proved; A cannot be perceived at C, but that the *ſubtil central matter* E, muſt be puſh'd towards C. in a *ſtraight Line*: And by the ſame reaſon B cannot be ſeen at D; but that the ſame matter E, muſt be driven towards D; and the Figure 12.

ſame

ſame may be ſaid of infinite *Lucid Bodies*, placed on the *ſurface* of that *Globe*.

This *Difficulty* only ariſeth from hence, becauſe it is hard for us to apprehend how the *parts* of *Liquid Bodies* can receive various *actions* at one and the ſame time; becauſe we have obſerved, that a *hard Body* cannot at the ſame time be moved divers ways at the ſame time. When yet in *liquid things* we know it is ſo; as may be ſeen by Experience in 2 or 3 *Tubes*, by Example A C, B D, F G, whoſe *Diameter* I ſuppoſe to be equal, and which are ſo placed croſſing one another, as that the ſpace in the middle E, be common to them all 3, and yet no greater than if it ſerved only for one of them. For let us ſuppoſe, that 3 *Men* do blow into the ends of all 3 of them A B F, the *Air* which is in the midſt of theſe 3 *Pipes*; E will at the ſame time be driven towards C, D, and G. Not as if therefore it were poſſible, for every one of the ſaid parts to remove at the ſame time to theſe 3 ſeveral *points*; but it is ſufficient if ſome one of them be moved towards C, others towards D, and others again towards G, and that 3 times ſwifter, than thoſe that fill the other parts of theſe *Pipes*; which is credible enough, foraſmuch as they are with triple ſtronger force puſh'd forwards. Now to apply this to the *ſubtil matter*, it will by this inſtance be eaſily conceiv'd, how the ſame tranſmits the different *Actions* of various *Lucid Bodies*, to different parts at one and the ſame time.

VII. *How it comes to paſs, that a Man who ſhakes a Torch, doth at the very ſame inſtant perceive the ſame in an oppoſit Looking-Glaſs.*

When a *Man* in the *Night* hath a lighted *Torch* in his *Hand*, and ſhakes it towards a *Looking-Glaſs*, at a quarter of a miles diſtance, he will no ſooner perceive the ſhaking in his own *Hand*, but that at the ſame time he will perceive it in the oppoſit *Looking-Glaſs*.

The Reaſon is, becauſe *Light* is rather an endeavour or tendency toward *motion*, than *motion* it ſelf. For tho' *motion* cannot be performed in an inſtant; yet is it not repugnant, for the *action* of *Light* to be tranſmitted in a moment at any diſtance whatſoever. For it is one thing to ſay, that *motion is performed in an inſtant*, and another, that *Light is tranſmitted in an inſtant*. The *Light* is tranſmitted after the manner of the *Action of a Stick*, every part whereof may be perceived or felt, at either end of the *Stick*, at the very ſame inſtant wherein it is produced. And conſequently nothing hinders but that a *lighted Torch*, being ſhaken, may be perceived in a *Looking-Glaſs* at a diſtance, at the ſame inſtant that the *ſhaking* is felt in the *Hand*; becauſe the propagation of *Light* is momentaneous, and needs no time for its paſſage.

VIII. *Why a certain Stone, found near* Bononia, *doth retain a Light in the Dark.*

Some *Stones ſhine* in the *Night*, eſpecially the *Diamond*. There is a *Stone* very common in the Country about *Bononia*, which if it be gently *calcin'd*, and afterwards expoſed to the *Sun*, doth take in ſo much *Light*, that when put into a *dark Room*, it is obſerved to retain ſome part of it, much like a *glowing Coal* that is covered with a little *Aſhes*, the *Light* whereof decreaſeth by degrees, and is at laſt quite put out.

We muſt not imagin, with ſome, as if the *Light* of the *Sun* were preſerved in the foreſaid *Stone*; foraſmuch as that *Light*, upon the withdrawing of the *Sun*, doth altogether vaniſh, as not being able to ſubſiſt a moment without its preſence; but rather conclude, that within the *Pores*, made by the *Fire* in the ſaid *Stone*, there be ſome *Fibres*, ſo very moveable, as that upon the preſence of the *Light* they are put into a great agitation, and upon the withdrawing thereof do ſtill continue the motion impreſt upon them; and conſequently move the ſurrounding *Globuli of the Second Element*. And therefore, when either in proceſs of Time, or by the ſtrength of *Fire*, ſuch *Fibres* are taken away, that *Luminous Virtue* immediately vaniſheth. The *Light* of this *Stone*, as was ſaid, can only be perceived in a *Dark Room*, becauſe it is very weak, and therefore eaſily overcome of a ſtronger Light. As is evident in *Rotten-wood*, *Crickets*, and other things that ſhine in the Night, which by Day give no *Light* at all.

IX. *Why a Diamond ſhines in the Night.*

The Reaſon why a *Diamond ſhines* in the *Dark*, ſeems to be this, becauſe in the *Pores* thereof the *particles* of the *3d Element* are ſo compreſt, that thoſe of the *2d Element* being puſh'd out, ſome of them are ſurrounded only with the *1ſt Element*, by which they are carried away, and the *Globuli* are driven or puſh'd forwards.

X. *Why it is that when a Man is ſtruck on the Head, he perceives Sparks of Light.*

When we receive a *knock* on the *Head*, or a blow on the *Eye*, we ſeem to perceive many Sparks of *Light*.

The Reaſon is, becauſe the motion of the *Globuli* is very much accelerated by the ſtriking *Fiſt*, which makes them break forth from the *Eye* with great force, and ſo cauſe the appearance of thoſe *Sparks*, which we ſee at that time. For by means of ſuch a *ſtroke*, the *Humours* are put into a great Commotion, and more eſpecially the *Arterial Blood*, which driving with a great force againſt the *Optick Nerve*, ſeems to exhibit the appearance of many *Sparks* of *Light*. For the Senſe of *Seeing* is nothing elſe but a *local Motion*, or rather *Preſſion*, whereby the fine filaments of the *Net-like Coat* of the *Eye* are ſtruck.

XI. *Why if we ſhut our Eyes after that we have, for a good while, been gazing on the Sun, we perceive an appearance of Light or Fire.*

The Affection which the *Light* impreſſeth upon the *Eye*, doth continue for ſome time. For when we ſhut our *Eyes*, after we have beheld the *Sun*, we think we ſee an appearance of ſeveral Colours.

The Reaſon whereof is, becauſe the fine *Fibres* of the *Optick Nerve*, do ſtill continue agitated by an unuſual motion. But foraſmuch as the ſaid Commotion wherewith they are ſhaken, even after that the *Eyes* are ſhut, is not ſtrong enough to afford ſuch a clear *Light*, as that is from whence it did proceed, therefore it repreſents only to us ſome weak *Colours*. And for the ſame Reaſon it is that ſome perſons do perceive ſome kind of *Light*, for ſome time after that a *Light* hath been put out. Yea ſometimes, tho' there be no *Lucid Body* to affect the neighbouring *Air*; yet ſometimes ſome ſharp *Humour* or *Vapor*, only moving the *Filaments* of the *Retina*, cauſeth an appearance of *Light* to the *Eye*.

XII. *The Light of a Candle doth appear more at Night, than in the Day time.*

The *Light* of a *Candle*, doth appear greater at *Night*, than in the *Day-time*, if the *Eye* be at ſome diſtance from it.

This may proceed from 2 Cauſes. *Firſt*, It may be occaſioned by ſomething in him that *ſees*, who when he doth not exactly know the diſtance of the *Candle*, may imagin that it is as far from him as a *Star*. Moreover, ſeeing that the Image of a *Candle*, framed in the bottom of the *Eye*, doth

doth much exceed that of a *Star*; it may make him think that it is really greater than a *Star*. Another Cauſe of this miſtake, may be from the *thing it ſelf* which is ſeen. For when at *Night* we look upon a *Candle*, that ſhines at a diſtance, we do not only perceive the *Light*, which comes to the *Eye* in a ſtraight Line, but that alſo which proceeds from the *thick Air*, and the *Opake Bodies* that ſurround it; for they alſo convey to the *Eye* the *Light* they have received, which being aſcribed to the *Candle* it ſelf, it cannot but appear much greater, than indeed it is.

XIII. *Why ſome Worms and Flies do ſhine in the Dark.* Some *Worms* and *Flies* do ſhine in the dark, ſhedding a kind of *Brightneſs* from their *Bodies*, through the *Air*.

It is probable that theſe *Inſects* have a certain matter exhaling from them, that reſembles the *ſweat* of other *Animals*; and that the ſame puſheth the *Globuli* of the 2*d Element*. And this ſeems to be the more probable, becauſe theſe *Animals* ceaſe to ſhine as ſoon as they are *dead*.

XIV. *Some Plants do ſhine.* Thus we ſee that *Rotten Wood* appears ſhining and *Bright* in the *Dark*, becauſe by the acceſs and receſs of its parts, the *Pores* thereof are ſo ſtraitned, that they contain nothing elſe but the firſt *Element*, whereby the 2*d* is agitated. Thus *Sea-water*, being vehemently driven and beaten with *Oars* and *Storms*, doth appear all on a flame, becauſe the Sea-water doth conſiſt of ſtiff *particles* of *Salt*; for by theſe penetrating little *Bodies*, the *particles* of the 2*d Element* they meet with in their way, may be ſo expelled, as that ſome of the *particles* of the 3*d Element*, may be only ſurrounded with the 1*ſt Element*, and by it be carried away, and driven on to the *Eye*, by a continued Range of the *Globuli*.

XV. *How Cats and Owls ſee by night.* 'Tis commonly believed that ſome *Animals* do emit *Light* from their *Eyes*, and thereby ſee in the dark, as *Cats*, *Owls*, *Dogs*, and other Creatures that hunt their *Prey* at *Night*, avoid dangers, and ſearch out hidden things.

But for all this is ſo confidently aſſerted, I queſtion not but that it will be found otherwiſe. For if any *Light* did proceed from the *Eye*, the ſame might be perceived by others, or might be concentrated in a *Burning Glaſs*, which could never yet be proved by any *Experiment*. We are therefore to conclude, that the foreſaid *Animals*, do only ſee by that *Action* which proceeds from the *objects*. For there is always more or leſs of *Light* in the *Night*; and therefore we ſee that *Snow* gives ſome *Light* in the dark, becauſe it reflects the *Rays* of *Light* it hath received, better than other *Bodies*, that are leſs white than it ſelf. Wherefore *Cats*, *Owls*, and other *Animals* perceive Objects in the *Night*, not becauſe they ſhed *Light* from their *Eyes*, which is afterward reflected from the *Object* to their *Eyes* again; but becauſe their *Retina* is more accurately framed, and more fit to receive the *Beams* of *Light*, ſo as that it can be affected by a very weak *Light*. For it is notorious, that the Apple of the *Eye* in *Cats* is ſo ſtraitned in the Day-light, eſpecially when the *Sun* ſhines ſtrong, that it appears ſcarce ſo broad as a *Thread*; whereas in the *ſhadow* it is ſo enlarged, as to be almoſt equal to the whole *Eye*.

XVI. *The Rays of Light do more eaſily paſs through Glaſs, than the Water.* The *Rays* of *Light* do more eaſily paſs through *Glaſs* than *Water*, and through *Water* than *Air*.

The Reaſon is, becauſe the *Action* of the *Subtil Matter*, wherein the Nature of *Light* doth conſiſt, is more hindred by the *Parts* of the *Air* that are ſoft and not well knit together, than by thoſe of the *Water*, which do more ſtrongly reſiſt it. For the more firm and ſolid the *parts* of any *Pellucid Body* are, ſo they be ſmall, the more eaſily do they tranſmit the *Light*. Hence it is that *Glaſs* and *Cryſtal*, becauſe of the firmneſs of their *parts*, do the more eaſily admit the *Beams* of *Light*.

XVII. *Why Paper dipt in Oyl is Tranſparent.* And much the ſame Reaſon may be given, why *Paper* beſmear'd with *Oyl*, becomes diaphanous; becauſe the *Oyl* entring into the *Pores* of it, which before, by reaſon of their winding or crookedneſs, could not tranſmit the *Rays* of *Light*, it doth ſmooth them, and change the *Figure* and bigneſs of them; and by this means cauſeth a different diſpoſition of the parts of the *Paper*.

XVIII. *Why Reflected Light is leſs bright, than that which is not Reflected.* *Reflected Light* is always leſs bright and ſhining, than that which is direct, or not reflected. For take the ſmootheſt *Looking-Glaſs*, and the moſt perfectly poliſh'd, whether by Nature or Art, yet will it never be endued with an entire and moſt abſolute continuity of its parts, without any inequality of the *Pores*, roughneſs or ſign of diviſion. Hence it is, that tho' all the *Beams* of *Light* fall upon it, yet ſome entring into the *Pores*, are ſwallowed up of them; or if they do reflect from it, becauſe of ſome inconſpicuous *inequality* of the extream parts, yet are they inſenſibly diſperſed; ſo that the entire *Light* is never ſo dully reflected, but that more or leſs it is loſt, and never reaches the *Eye*.

CHAP. IX.

Of Colours.

I. *Whether the Colours of a Peacocks Tail, and the Necks of Doves be true Colours.* A *Peacocks Tail*, and the *Feathers* of a *Pigeon* do wonderfully change their *Colours*; as LUCRETIUS elegantly expreſſeth it.

So Plumes that grow around the Pigeons Head,
Sometimes look briſker with a Deeper Red;
And then in different poſition ſeen,
Shew a gay Skie, all intermixt with Green:
And ſo in Peacocks Tails, all fill'd with Light,
The Colour varies with the change of ſight.

These *Colours* are cauſed when the *Peacocks Tails*, and *Necks* of *Pigeons* are turned towards the *Light*; and by reflexion or refraction do ſend back the ſaid *Rays* to the *Eye*. They are commonly called *appearing Colours* only, and reckon'd amongſt thoſe *Images* that deceive us, and whoſe entire Eſſence or Nature conſiſts in their appearance, or ſeeming ſuch. But the reaſon why they aſſert this, I cannot apprehend: For if they admit *Colour* to be nothing elſe, than the *Light* it ſelf, modified in the *ſurface* of *Bodies*, why may not they own thoſe *Colours*, which they call *ſeeming*, to have as truly the Nature of *Colour* as any other? For can the ſhort duration of the *Cauſe*, deſtroy the *Truth* of the *Effect*? Or doth not a *Son* deſerve that name, becauſe he *dies* almoſt as ſoon as he is born? Who will affirm, that the *Greenneſs* of *Graſs* or *Herbs*, which for ſome days only doth delight our *Eyes*, is leſs a *Colour* than the *Greenneſs* of an *Emrald*, which continues ſo much

longer? For by the same *Argument*, the flame of *Lightning* or *Gun-powder* will be no true *Flame*, because of its suddain vanishing and disappearance. For the lasting or continuance of *Colours* imports nothing to their Truth and Reality; and those which continue only for a moment, are no less *Colours*, than those which lastingly do affect the *Eyes*.

II. *How Colours come to be varied.* The Cause therefore of the variation of *Colours* in the *Peacocks Tail*, and the *Necks* of *Doves*, is the different *Reflexion* and *Refraction* of the *Rays*, made by the thin *Hairs* of their *Feathers*, because of their various admission of the *Luminous Beams*. Thus those *Pictures*, made of *Feathers*, which are brought out of the *East Indies*, according to the variety of their situation, do exhibit a *Violet Colour*, or bright *Blue*, or a curious *Emrald Green*; forasmuch as the soft *Feathers* whereof they do consist, have their *surfaces* so ordered, as diversly to reflect the *Light*.

But this being besides my present scope, I return to prosecute my *Experiments*.

III. *Two Looking-Glasses, made of different Marble, do differently reflect the Image of the Sun.* Let two *Llooking-Glasses* be made, the one of *white*, the other of *black Marble*; that of *white* being exposed to the *Suns Beams*, will represent to us a more clear and distinct Image of the *Sun*, than that of the *black*, from which only some *weak Rays* will rebound, which being not sufficiently united together, will only produce a confused *Image* or Similitude of the *Object*.

The Reason of this is, because the action of the *Light*, whereby the Parts of the *Subtil Matter*, push'd on by the *Lucid Body*, do tend towards the *Black Marble*, is almost quite extinguish'd or swallowed up by it, so as that very few of the *Rays* are reflected: Whereas the *White* doth altogether remit the *Action* of *Light*, and almost reflect all the *Beams* that fall upon them. For tho' *White* and *Black Marble*, consist almost of the very same *parts*, and no difference is discernible between them by sense; yet it is not to be questioned, but that in the *Black* some soft parts are to be found, which swallow up part of the *Beams*, and break the force of them. So that the *Black Marble* differs from the *White*, much alike as a *Pumice-stone*, whose *Pores* are filled with melted *Pitch*, differs from another *Pumice-stone*, whose *Pores* are only filled with *Air*: For as the *Grains* of *Sand* cast against the latter, would rebound thence, whereas those cast against the other would be deaded; in like manner, all the *Light* which falls upon the *White Marble* is reflected; whereas that which *lights* on the *Black*, is mostly swallowed up.

IV. *What is the Cause of the Whiteness that is in Bodies.* The same is apparent in other *Bodies*; for if *Water*, for instance, be strongly agitated and shaken together, it becomes of a *White Colour*, and after that the *Bubbles* of the Froth are broken, it is Transparent; which is a great Argument, that the cause of this *Whiteness* is, when the *Light* is wholly and entirely reflected from the small *Bubbles* of the *Froth*, as from so many *Looking-Glasses*. And accordingly the *Black Marble* is like Hangings, which upon the casting of a *Ball* against it, doth receive motion, but doth not rebound; whereas the *White* is like a hard Wall, which sends it back, and without any motion of its own, doth reflect it.

V. *Why White Marble is less suscep-* Hence it is, that if you take 2 Polish'd pieces of *Marble*, the one *White*, the other *Black*; and in hot *weather* expose them to the *Sun-beams* for some time, you'l find that the *Black* will be *very hot*, whereas the *White* will, for all that, in a great measure, continue *cold*. Whereof no other reason can be given, but that the *Black*, because of its many Cavities, doth freely admit the *Globuli* of *Light*; whereas the *White*, because of its *closeness*, doth reverberate the received *Light*, retaining nothing of it. Accordingly as we daily observe in *whited Rooms*, which do reflect more *Light*, and do, in a manner, send it all back again from them. Hence it is, that when the *Light* of the *Sun* is admitted into a *Darkned Room*, through a little *hole*, if the *Rays* be received upon a *white Paper*, they appear very bright and shining; whereas they shew very weak and faint, when they light upon a *black Body*. *ptive of Heat, than Black Marble.*

VI. *Polish'd Marble appears of a blacker Colour than that which is Rough.* *Polish'd Marble* is of a *blacker Colour*, than that which is *Rough*.

The Reason is, because in the *Rough* there be many Prominences, which every way reflect the *Light*. For the *Ray* which is reflected from one part of the *Body*, goes one way, and that which is reverberated from another part, another way. But a *Polish'd Body*, forasmuch as it consists only of one continued *Superficies*, therefore it reflects fewer *Rays* to the *Eye*. Moreover, seeing there is no *Body*, in Nature, so *Black*, which doth not consist of many parts, which being separated from the rest, would constitute a *white Body*, as the difference there is between the *Polish'd* and *Rough Marble* doth abundantly testifie: We may say that *Polish'd Marble* is most *black*, because its *white* parts do reflect the Light they receive, towards the same part; where if there be never an *Eye* to admit it, it is the same with respect to it, as if the *Light* were quite extinquish'd. But when the *Eye* is placed in that part to which the reflexion tends, it perceives this *Light* in the *Marble*, together with the *Colours* and Figure of the Objects, from whence the *Light* doth proceed; no otherwise than if it did proceed from a *Looking-Glass*.

VII. *A perfectly Polish'd Body can only be seen on one side.* Now that an absolutely *Polish'd Body* doth only reflect one *Ray* to the same point of the *Eye*, may be thus demonstrated. Let B F, be suppos'd to be a perfectly polish'd Plain, and let the *Light* be in the Point A, and the *Eye* at H, let the reflex *Ray* be D H, so as that the *Angles* A D B, and H D F be equal; it is evident, that no other *Ray* derived from A, will be reflected to H, supposing that the *surface* B F, be absolutely smooth and even. For let there be any other *Ray* of incidence, suppose A C, I say, that the *Angle* A C B, is greater than the *Angle* A D B; wherefore supposing an equal *Angle* of Reflexion A C I, the reflected *Ray*, C I, will never reach to H, nor will ever concur with D H, but rather fall wider from it, the further it is drawn. And the same must be said of all the other *direct* incident *Rays* between B and D. Wherefore there will only one *Ray* be reflected at H, *viz.* D H. I have said before, if the *Body* be perfectly *smooth*, for if it be not, the case will be otherwise, upon the changing of the nature of the Plain. Figure 13.

VIII. *Some Bodies retain always the same constant Colour, as Coals, Snow, &c.* Some *Bodies* do constantly keep the same *Colour*, and which way soever they are turned towards the *Light*, do always reflect it after the same manner; so *Coals* always appear *Black*, and common *Snow*, *White*.

The

The cauſe of this conſtant *Colour* is to be aſcribed to the Diſpoſition and Situation of the *Parts*, which as long as it continues the ſame in *Bodies*, they admit the *Light* at certain *Angles*, and accordingly reflect it to the Sight. For *Charcoal* is *black*, becauſe its *ſurface* is rough and uneven, by reaſon of innumerable furrows and chinks, which choak the *Rays of Light*, and break their force. Which may be evinced, not only by reaſon, but by our very *Senſes*. For if a *man* do gently handle *Charcoal*, he will be ſenſible of a kind of *Roughneſs*, ſomething like that we feel in a *Pumice-ſtone*; which, as I ſaid before, is not capable of being poliſhed. For whilſt *Wood* is burning, much Smoak and Exhalation flies away from it, by the force of the *Heat*; and therefore the *Fire* being rarefied between the Cavities of the *Wood*, doth break its *priſon* and dilate the *pores*; into which, when the *Rays of Light* enter, they are there ſwallowed up and entangled, ſo that they cannot rebound to the *Eye*.

IX. *In what ſenſe it is that Colours are ſaid to be in Bodies.*

But yet we muſt not imagine with ſome, that *Colours* do formally exiſt in *Bodies*, but effectively only, inaſmuch as they produce them in the *Eye*, by means of a certain diſpoſition of the *Inſenſible parts*, and the *Reflexion* of the *Light*: In the ſame manner as a *Needle*, which is deſtitute of all pain, yet being thruſt into the *Skin*, doth by its *motion*, *figure* and *hardneſs*, produce Pain there.

Thus all *Sulphurous matters* exhibit a *Red Colour*: As when the *Spirit of Turpentine* being digeſted with the *Calx of Lead*, yields a *deep Red*; and the *Spirit of Soot* mixt with any *acid Liquor*, or *Common water*, affords a *white* or *milky Colour*. Thus the *Light* proceeding from 2 *Lanthorns*, the one of *red Glaſs*, the other of *blew*, being receiv'd on a *Paper*, will repreſent there a *Purple Colour*. All which Inſtances manifeſtly evince, that *Colour* is not inherent or fixed in a *Body*, but only a reſult of the Reflexion of *Light*.

X. *Why beaten Glaſs ſeems to be white.*

Glaſs, when it is whole and extended in *Panes*, is tranſparent, that is, of no *Colour*, or if it have any, it is rather of a *black* than *white Colour*; but when beaten in a *Mortar*, it appears *white*.

The Reaſon is, becauſe *beaten Glaſs* hath many *Surfaces*, which every one of them do receive the *Light* and reflect it again, as ſo many *Looking-Glaſſes*. For ſeeing that *Glaſs* is deſtitute of all *Moiſture*, and that all its parts are of a *round figure*, as may be experienc'd by the help of a *Microſcope*, one of them reflects one part of the *Light*, and the other, another, and ſo on, ſo that they reflect the whole *Light*, and that after the very ſame manner as they have received it. Hence it is that *White Bodies* are, of all others, the leaſt *opake*; becauſe they reflect the *Rays* of *Light* from every point of them, and ſuffer none to be ſwallowed up of any of their Cavities.

XI. *What is the Cauſe of the Whiteneſs in Snow.*

Neither is there any other Cauſe of the *whiteneſs* of *Snow*, which conſiſting of *Bubbles*, doth ſend the *Rays* to the *Eye*, according to the multitude of the *Bubbles* whereof it is compoſed. Nor is this contrary to what hath been ſaid before, that from every *Bubble*, one *Ray* only is ſent to the *Eye*: For ſince they are not ſenſible, neither do they hinder, but that abundance of continual *Rays* may be directed to the *Eye*. Hence it is that *Snow*, which is nothing elſe but *Frozen-water*, yet doth appear whiter than *Ice*; for ſeeing that the ſurface of *Ice* is not ſo much curled, as the ſurface of *Snow*, and that there are many Devexities or *Roundings* in *Snow*, from whence the *Light* may be reflected, which are not to be found in *Ice*; it cannot be, but that *Snow* muſt appear whiter than *Ice*. And for the ſame Reaſon it is, that *water* beaten together, turns to *froth*, by its being divided into round and ſmall *parts*: For if the *Bubbles*, whereof the *Froth* conſiſts, be ſo great, they will ceaſe to yield a *white Colour*. Thus likewiſe the *Whites of Eggs*, when beaten, loſe their Tranſparency, and become *white*; and *Cryſtalline Glaſs*, heated in a ſtrong *Fire*, and quenched with *water*, is reſolved into ſo many ſlits, that it appears altogether *white*.

XII. *Fiſhes tending to putrefaction, do yield no Colour at all in the Pneumatick Engin.*

Rotten Wood, as alſo *ſtinking Fiſh*, are of a kind of *whitiſh Colour*, when expoſed to the *Air*; but when put into the *Pneumatick Engin*, upon the extraction of the *Air*, do loſe all *Colour*.

The Reaſon is, becauſe the *particles* of putrefying *Bodies*, are agitated in ſuch a manner as is neceſſary, for the cauſing of the Senſe of *Light*. For the *Corruption* of any *Body* is cauſed by the motion of its *parts*, whereof ſome fly away and are ſeparated from the reſt; and thoſe that remain, impart their Vibration or Motion to the interjacent *Air*, and by this means do afford a weak *Light* to it. But ſeeing that all the *Air* is ſuppoſed to be extracted out of the *Pneumatick Engin*, it needs not ſeem ſtrange to us, if the *Fiſh* which ſhined before, doth no longer ſhed any *Light*. For the *Air*, by its *Elaſtick virtue*, doth aſſiſt the agitation of the *Light*, and where its motion is ſtronger, there the *Light* alſo is increaſed.

XIII. *Why the lower part of the Blood in a Porringer appears of a darker Colour, than that at the top.*

Thus FRACASI is of Opinion, that the Reaſon why the *Blood* appears of a *darker Colour* at the bottom of a *Porringer*, than at the top, is not becauſe, as the common Opinion is, that part is the more *Melancholy* portion of the *Blood*; but becauſe the lower part of the *Blood* is not ſo much expoſed to the *Air*, and therefore appears leſs *Ruddy* and Florid, than that which is on the top.

XIV. *Why the Blood that is contain'd in the Arteries and Veins, is Red.*

Why the *Blood* that is in the *Arteries* and *Veins* is *Red*, appears from what hath been ſaid in my *Inſtitution of Philoſophy*, *viz.* That the motion of the *Globuli* of the *ſecond Element*, which are the Cauſe of *Light*, is twofold, the one whereby in a ſtrait Line they are carried to our *Eye*; the other, whereby they are whirled about their own *Centers*. So that if they be whirl'd about much ſlower, than they move in a right Line, then the *Body* whence they are reflected will appear *blew* to us; but if they be whirl'd about much ſwifter, then it will ſeem *red*. Now no *Body* can be diſpoſed to make them whirl about more ſwiftly, but ſuch an one as conſiſts of *Branchy parts*, and thoſe ſo thin and near one another, as to have nothing about them, ſave only the Matter of the *firſt Element*, ſuch as the *Parts of Blood* are. For the *Globuli* of the *ſecond Element* meeting with the Matter of the *firſt Element* in the *ſurface* of the *Blood*; which Matter doth without ceaſing obliquely paſs through the ſame, and that with great ſwiftneſs, out of one *pore* into another, ſo as to be moved after a different manner from the *Globuli*; they are forced to whirl about their own *Centers*, by the Matter of the *firſt Element*; and

and that more ſwiftly than they could be forced by any other Cauſe, becauſe the *firſt Element* exceeds all other *Bodies* in ſwiftneſs.

XV. *Why burning Coals, or Red-hot-Iron are not ſo red as Blood.*

And the ſame is the Reaſon, why *Red-hot-Iron* and *Burning-Coals* are *red*; even becauſe very many of their *pores* are fill'd only with the *firſt Element*. But becauſe the ſaid *pores* are not ſo narrow as thoſe of the *Blood*, and that there is much of the *firſt Element* in them, to produce *Light*, hence it is that their *Redneſs* differs from the *Redneſs* of the *Blood*.

XVI. *Of a Perſon that diſtinguiſheth Colours by the touch of his hand.*

Very Famous and Credible perſons give us an account of a certain *blind Organiſt*, who lived near *Utrecht* upon the *Maes*, who had ſuch an exactneſs of *Feeling*, that by the touch of his *Hand* only, he was able to diſtinguiſh ſeveral *Colours*.

It will not be very difficult to aſſign the Reaſon of this wonderful Effect, if we conſider that the *interruption* of parts in *Bodies*, doth very much conduce to the production of *Colours*; foraſmuch as it is evident, that moſt *Colours* proceed from the *roughneſs* of *Bodies*, and the *figure*, *order*, *ſituation* and *motion* of the *parts*. As is evident in *red Marble*, the poliſht part whereof is very different in *Colour*, from that which is *rough*. So likewiſe we may perceive by a *Microſcope*, that the *yellow* parts in a piece of *Silk*, are very different from the *blew*. Foraſmuch therefore as there is ſo great a variety of Parts in *Colour'd Bodies*, which may admit a Reflexion or Refraction of *Rays*, we may conclude, that it ſeems probable enough that the foreſaid *blind Man* might have ſuch a quick *Touch*, as to be able to diſtinguiſh colour'd *Objects* by the roughneſs or unevenneſs of their *parts*.

XVII. *The mixture of Bodies produceth new Colours.*

Several *Bodies* mingled together obtain a different *Colour* from what they had before: Thus *Oil of Anniſeed*, mixed with *Oil of Vitriol*, turns *red*; *Spirit of Turpentine* poured upon *Sugar of Lead*, or *calcin'd Lead*, produceth a *red Tincture*; and the *yellow Gall* in *Animal Bodies*, according to the Opinion of *Phyſicians*, is the product of the mixture of aduſt *Sulphur* and *Salt*.

This production of different *Colours* is cauſed by the inward diſpoſition of the *parts* of *Bodies*. For it is certain, that from the alteration of the leaſt *parts* of one *Body*, a different *Colour* muſt ariſe; as appears evidently to the *Eye* in *Herbs* that are beaten in a *Mortar*. For the temperament and ranging of the *Parts*, is, as it were, the firſt Rudiment of *Colours*, which upon the appearance of *Light*, and its being diverſly reflected and refracted from thoſe *particles*, doth ſuper-add the laſt and moſt abſolute perfection to *Colours*. Thus the Stone *Magneſia*, which for colour and hardneſs doth reſemble a *Load-Stone*, being in a certain proportion added to *Glaſs*, renders it perſpicuous, and quits it of its *green Colour*; but if more than is neceſſary be added to it, it makes it *black*. Thus an *Apple cut in two*, at firſt appears *white*, then turns *yellow*, and laſt of all *black*, according as the *ſurface* of it becomes differently diſpoſed, by the drying of its *parts*.

XVIII. *How two pellucid Bodies can produce a black Body.*

The tranſparent and clear Infuſion of *Galls* being mixed with a Solution of *Vitriol*, makes *Ink*; to which if you afterwards add *Spirit of Vitriol*, or *Aqua-fortis*, the *black Ink* will become tranſparent again, as *Spring-water*; and if you drop ſome Drops of *Oil* of *Tartar* into this clear *Liquor*, it will be turned again into *Ink*. The *blew Tincture* of *Violets*, infuſed into the *Oil of Vitriol*, becomes of a *purple Colour*; to which if you add a few Drops of *Spirit of Harts-horn*, the *purple Colour* will be changed to a *green*.

The Reaſon why 2 clear *Liquors* mingled together make *Ink*, is, becauſe the *particles* of either of them are brought nearer together, ſo as to hinder the paſſage of the *Rays* of *Light*. And whereas the ſaid *Ink* afterwards, upon the pouring another Liquor into it, becomes clear again, the Reaſon is, becauſe the *particles* of the new added *Body*, do ſeparate the Parts that before were contiguous, and conſequently make an open paſſage for the *Light*, to paſs freely, as before.

XIX. *The Cauſe of the variety of Colours, proceeding from the mixture of Liquors.*

The Difference of *Colours* proceeding from the *mixture* of *Liquors*, is to be fetch'd from the *ſmall particles* contained within the *pores* of each *Liquor*, which being changed in *ſituation* and *poſition* by the *Liquor* that is poured into them, do tranſmit the *Rays of Light*, variouſly refract or reflect them, and conſequently produce different appearances of *Colours*. For, as was mentioned before, when the *Globuli* have more Right *motion* than Circular, they afford a *Violet Colour*; if they have more Circular *motion* than Strait, the *Liquor* appears *yellow*; but if the *Globuli* have much more Circular *motion*, than Right *motion*, they produce a *Red colour'd Liquor*: Again, if the *Æthereal Globuli* have more Right *motion*, than Circular; but yet leſs than the *Globuli* of thoſe *Rays* that produce a *Violet Colour*, then they yield a *blew*. And in like manner we are to conclude concerning all other *Colours*, the variety and ſudden changes whereof, in *Liquid Bodies*, is chiefly to be attributed to precipitation.

XX. *Sharp and ſowre Salts alter the Colours of Bodies.*

Thus we find, that ſharp and acid *Salts* cauſe a thouſand changes in the *Colours* of thoſe *Liquors* with which they are mixed, according to the different Nature of the ſaid *Liquors*. As for Inſtance, the *Oil of Vitriol* makes a *black* compoſition, with the infuſion of *Galls*. Common *Brimſtone* diſſolved in the *Oil of Tartar*, becomes of a fair *Citron colour*. *Spirit of Nitre* turns the Juice of *Herbs* as *white* as *Milk*. *Spirit of Wine* turns *red*, when it hath been digeſted a while with the *Salt of Tartar*. The *Syrup of Violets* turns *green*, by the mixture of an *Alkali*; and *red*, by adding an Acid to it. *Acids*, or Sowre things deſtroy *blew Colours*, and *Alkali's* do reſtore them again. The Infuſion of the *Indian Wood*, affords an *amber Colour*, when mingled with *Acids*. And the Solution of Common *Brimſtone*, made by an *Alkali*, turns *white*, by adding an *Acid* to it. All which ſolely proceeds from thoſe *Diſpoſitions* which *Acid* and *Alkali Salts* produce in the *pores* of thoſe *Liquors* to which they are added, which is ſuch, that the *Light* which penetrates them, receives all the Modifications that are neceſſary for the ſeveral *Colours* we find produced by theſe *mixtures*.

XXI. *Why Powders are generally white.*

Moſt *Powders* are *white*, if they be dry and beaten, or ground very ſmall.

Becauſe all thoſe ſmall *Bodies* into which the *Powder* is reſolved, are *Spherical*, and like ſo many *Globuli*, which reflect all the *Rays of Light* to one *point*. And if it happen that the *grains* of any *Powder*

Powder do terminate in a *Point* or *Angle*; then they do not give a *white Colour*, but some other. For I have often taken notice, by making use of a good *Microscope*, that the *grains* of *white Sand* are either Round, or approaching to a *Conical figure*, that is, of a smooth *crooked surface*; but that the *grains* of *Sand* of any *Colour*, were Rough and furnished with many prominent *Angles*.

XXII. *Why Veal, after it is dresst by the Fire, looks white.*

Veal, and *Hens* or *Capons*, are of a *white Colour*, when boiled or roasted, and lose the *red Colour* they had, when they were yet *Raw*.

The Reason is, because the *Heat* hath chas'd away the *Moisture* that was before in the *Veal*, as well as in the flesh of *Hens*, *&c.* for *moisture* shut up in the *pores* of *Bodies*, is a hindrance to *Whiteness*, as is evident in all dry things, which by the separation of their *moisture* become *white*; because *Moisture* doth not permit so much fraction as the *Air* doth; and yet so much is necessary to cause *Reflexion*. Hence it is, that a *Body* that is newly whited with *Quick-lime*, appears at first to be of a *dusky Colour*, and afterwards, in success of time, becomes *white*; because at first it hath much *moisture* mixed with it; which being exhal'd into the *Air*, and the *Quick-lime* dried, yields a *white Colour*.

XXIII. *Cloth exposed to the Sun changeth its Colour.*

Colours wherewith *Cloth* or *Silks* are *died*, do soon lose their Lustre, by being long exposed to the *Sun*, and degenerate into a faint Liveless *Colour*.

This proceeds from a twofold Cause: *First*, Because many of the *particles* of *Dyed Bodies*, which compose the *Tincture* are exhaled, by the *Suns* agitation. *Secondly*, Because many little *Bodies*, that wander up and down the *Air*, do thrust themselves into the *pores* of the *Cloth*, which by covering its Lustre, efface its former *Colour*. Wherefore they that deal in *Cloaths*, have a care that they be not long exposed to the *Air*, but keep them shut up.

XXIV. *The Spirit of Vitriol is hurtful to the Teeth.*

Some make use of the *Spirit of Vitriol*, to whiten their *Teeth*.

But this may well be reckon'd amongst Vulgar Errors, since it is notorious, that the *Spirit of Vitriol*, in conjunction with an *Alkali*, doth produce a *yellow*: And forasmuch as something of an *Alkalous Nature* is continually transfused from the *Gums* and other parts of the *Body*, it must follow that the *Spirit of Vitriol* being commixt with such a *Salt*, must rather make them of a *yellow Colour*, than any whit conduce to the whitening of them.

XXV. *Sugar, and hot Meat, blacken the Teeth.*

It is observed, that the frequent use of *Sugar*, and too hot *Meat*, does blacken the *Teeth*; because *Sugar* abounds with *Volatile Salt*, whose sharp-pointed *particles* do Worm-eat the substance of the *Teeth*, and make great *pores* in them; wherein the *Lucid Rays* being suffocated, do produce a *black Colour*. And the same effect is also caused by *hot Meat*, the agitation of whose *particles* do likewise bore many Cavities in the *Teeth*.

XXVI. *What is the cause of those various Colours which appear in a long figur'd Glass exposed to the Sun.*

A *Glass Vessel* of a long *figure*, like a *Gourd* or *Cucurbit*, being fill'd with *water*, and expos'd to the *Sun-beams*, so as that they may enter obliquely through the narrow Mouth, at the upper part of the *Vessel*; these *Sun-beams* falling upon a *white Paper*, or piece of *Linnen*, will represent various *Colours*. For the uppermost *Colour* will be *Red*, the Lowermost *Blew*, and the Middlemost *Whitish*.

The Reason of this appearance, is to be fetch'd from the various Transmission of the *Rays*: For Experience tells us, that *Rays* passing *obliquely* or slantingly through a Hole, must needs be *refracted*, which *Refraction* is the cause of all this variety of *Colours*; forasmuch as the *parts* of the *subtil matter*, which we conceive as so many little *round Bodies*, which role continually through the *pores* of *Earthly Bodies*, are variously moved, according to the diversity of the Causes which determine their *motion*. So as that the *Colour*, which is represented at the upper part of the *Glass*, is *red*; because the *Heavenly Globuli*, which transmit the Action of the *Light*, are much more swiftly whirl'd round, than they tend in a *Right line*. But a *blue Colour* is represented in the lower part, because the same *Globuli* are more slowly in their circular motion, than in their direct and strait tendency. Because there is supposed to be a Cause which hinders their Circumvolution. But in the Midst a *white Colour* is seen, because the *Heavenly Matter* there hath an equal proportion of Circumrotation and Procession. For those *Bodies* are called *White*, in which the circular motion of the *Globuli* is equal to their tendency in *Right lines*. So that the whole difference of *Colours* doth only depend on the different proportion of these motions of the *Celestial Matter*. As hath been more at large declared in my *Institution of Philosophy*.

XXVII. *Of a Wood brought from Mexico, which gives a various colour to Water.*

ATHANASIUS KIRCHERUS, in his *Book* of *the Art of Light and Darkness*, tells us of a sort of *Wood* growing about *Mexico*, which the *Inhabitants* call *Coati*, which communicates a great variety of *Colours* to *water*. For if a *Vessel* be made of the same, and filled with the clearest *water*, it after a little time standing turns the *water* into a *blue Colour*, which continues in the *water* as long as it stands in the said *Vessel*; but being poured out into a *Crystalline Bottle*, and expos'd to a full Light, it recovers its former perspicuity; but if it be brought into the *shade*, it turns *green*, and if it be brought into a yet *darker shade*, it appears *red*, and that very deep, as approaching somewhat to *blackness*.

The *water* put into a *Vessel* of this *Wood*, appears first to be of a *blue Colour*, because it cannot be question'd, but that the infused *Liquor* doth enter the *pores* of the *Wood*, and fetcheth out many of the small *particles* thereof; which being mixed with the *moisture*, are the cause why the *Rays of Light* are in that manner refracted and reflected, as is necessary for the production of a *blue Colour*. Again, when this *water* is pour'd into a *Glass Bottle*, it appears *clear* and transparent, because of the full *brightness* of the *Sun*, to which it is exposed. For tho' the *particles*, which the *water* had fetched out of the *wood*, did reflect or refract some of the *beams*; yet now the prevailing power of the *Light* doth efface that disposition of Parts, and makes its way without any let or hindrance through the *water*. Thus we find by daily Experience, that the *Sun* shining through a *Glass Prism*, doth not exhibit the *Colours* of the *Rainbow*, tho' they be exactly represented on a piece of *Paper* that receives the said *Rays*. Then afterwards this *Bottle* being

removed out of this great and ſtrong *Light*, into a more moderate or ſhaded *Light*, is turned into a curious and pleaſant *Green*; becauſe from the *brightneſs* of the *Sun*, which affords abundance of *Light*, the *blue Colour*, which the *Wooden Veſſel* did produce, is changed into a *green*, which is compounded of a *blue* and a *yellow*. And laſt of all, when the *Bottle* is brought into a more ſhady place, the *water* appears of a deep or *dark red*; becauſe the *Redneſs* is weakned by the decreaſe of the *Light*, and is changed into a kind of *Ruſty Colour*.

XXVIII. Brazile *Wood communicates a Red tincture to water.*

In like manner we know, that *Brazile Wood* communicates a *red Colour* to the *water* wherein it is boiled; which being put into a *Drinking-glaſs*, if a little diſtill'd *Vinegar* be added to it, it immediately is turned into the *colour* of *Straw* or *Amber*: From which ſudden change of *Colours*, we have good reaſon to conclude, that all *Colours* do ariſe from the various texture of the *parts*, and the different reflexion of the *Light*.

XXIX. Nephritick *Wood yeilds a Golden, blue, and yellow Colour.*

There is alſo another kind of *Wood*, which hath taken its name of *Nephritick Wood*, from the great uſe it is of in curing the *Gravel*, the parts whereof being infuſed in *water*, and put into a *Glaſs Vial*, do after a few hours tinge the *water* of a *Golden Colour* if the *Vial* be placed between the *Eye* and the *Window*; but if the *Eye* be placed between the *Window* and the *Vial*, it will appear of a *blue Colour*. For when the *Rays of Light* do enter into the *Liquor*, they become tinged with a *yellow Colour*; but the ſame repreſent a *blue*, when the *Rays* reflect from the *Vial*. And if you pour an *Acid Liquor* upon it, then the *blue Colour* will vaniſh, and the whole *Liquor* will appear of a *Gold Colour*.

The Reaſon of this is probably no other, than that of the foregoing: For it is evident, that this *Wood* doth conſiſt of *Tinging particles*, which are eaſily reſolved in the *water*, and ſo far ſeem to be much of the Nature of *Salt*; which *particles* entring the *pores* of the *Water* do ſo refract the *Rays*, that they appear tinged with a *Gold Colour*. And if you admit the *Light* of the *Sun* through ſome Hole, into a *dark Room*, and place the *Vial* full of the Infuſion of this *Nephritick Wood*, partly within the *Cone of Light*, and partly without it, you will obſerve a vaſt variety of *Colours*, cauſed by the various degrees of the *Refraction* of the *Light*. Now the Reaſon why, after that the *blue Colour* hath been extinguiſht by an *Acid Liquor*, it ſhould be reſtored by the Affuſion of *Oil of Tartar*, or a *Sulphureous Salt*; and on the contrary why, when the *Gold Colour* is vaniſhed, it is reſtored by the addition of an *Acid Liquor*, is, becauſe *Acid Salts* do cut and flaſh the tinging *particles* into leſſer diviſions, or at leaſt precipitate them, and ſo make the *Colour* to appear more weak and dilute.

CHAP. X.

Of Occult Qualities.

I. *What Occult Qualities are.*

Occult Qualities, are by the *Peripaticks* called *Hidden Powers*, by which *Natural things* do act or ſuffer any thing, and whereof no prior Reaſon can be aſſigned, as immediately proceeding from the *ſubſtantial Forms* of things. But our *Modern Philoſophers* are at a loſs about what the ARISTOTELEANS means by all this *Gibberiſh*, who denying all *ſubſtantial Forms*, deſpair of ever knowing what theſe *Occult Qualities* are, which are the immediate products of them. Wherefore the abſtruſeneſs of ſome *Qualities* doth ſeem only to depend on the different *Hypotheſes* of *Natural Principles*; ſo as that to thoſe who follow the *Peripatetick Hypotheſis*, the *Ebbing* and *Flowing* of the *Sea*, and the *Conjunction* of the *Iron* with the *Load-ſtone*, appear to be abſtruſe and hidden *Qualities*; whereas, according to the *Principles* of *Corpuſcular Philoſophy* they are moſt clear and evident effects.

II. *Of the Common Opinion, that a Sponge attracts water.*

A *Sponge* is commonly ſuppoſed to attract *water*, and to draw it upwards.

If we warily conſider the thing, we ſhall find that a *Sponge* is very improperly ſaid to attract *water*; whereas on the contrary, the *water* doth rather mount upwards to the *Sponge*, and intrude it ſelf into its *pores*. For as ſoon as the *Sponge* toucheth the *water*, it ſomewhat preſſeth the ſame, and makes the preſſed part of the *water* to mount up, and enter into the *pores* of the *Sponge*, as is evident in a *writing Pen*, which no ſooner toucheth the *Ink*, but it mounteth up into the *Pen* by means of the *Slit* of it. For if the *Point* of a *Pen* without a *Slit* be applied to the *Ink*, no part of the *Liquor* will aſcend; or if any part of it ſtick to the *Quill*, it immediately drops down. The mounting up therefore of the *Water* is cauſed by the preſſion of the *Sponge*, whereby the *Air* is thruſt out of its place; which *Air* afterwards puſhing againſt the *ſurface* of the *Water*, drives it upwards, and by ſome Force makes it to enter the *Body* that lies upon it.

III. *How New Bread attracts water.*

New Bread put into *Wine*, or any other *Liquor*, will draw up the ſame 2 or 3 *Fingers* breadths high, and contrary to the *Laws of Nature*, without any Preſſion, operates at a diſtance.

The *Wine* enters into the Cavities of the *Bread*, becauſe they are bigger than is neceſſary, for admitting the *parts* of the *Air* only; and therefore the *parts* of the *Air* that are ſhut up in them, are on every ſide ſurrounded with the *Subtil Matter*, which doth more ſwiftly agitate them, than they would be moved elſewhere, in caſe they continued entangled amongſt themſelves. And foraſmuch as all *Bodies*, which move in *places* that are too narrow for them, do ſtrive to get out of them; it accordingly happens, that whilſt the parts of the *Air* do go forth from the *pores* of the *ſurface* of the *Liquor*, that toucheth it, the *parts* of the *Water*, or any other *Liquor*, do immediately follow it, and poſſeſs themſelves of the relinquiſht place. And becauſe alſo the parts of the *Liquor* do better fill the Cavities of the *Bread*, they are not ſo ſwiftly agitated in them, as the parts of the *Air*; and therefore do not endeavour to quit the ſame, except only in order to enter the higher *pores* of the *Bread*, and take up the place of the *Air*, which ſtrives to get out of the *Pores* thereof.

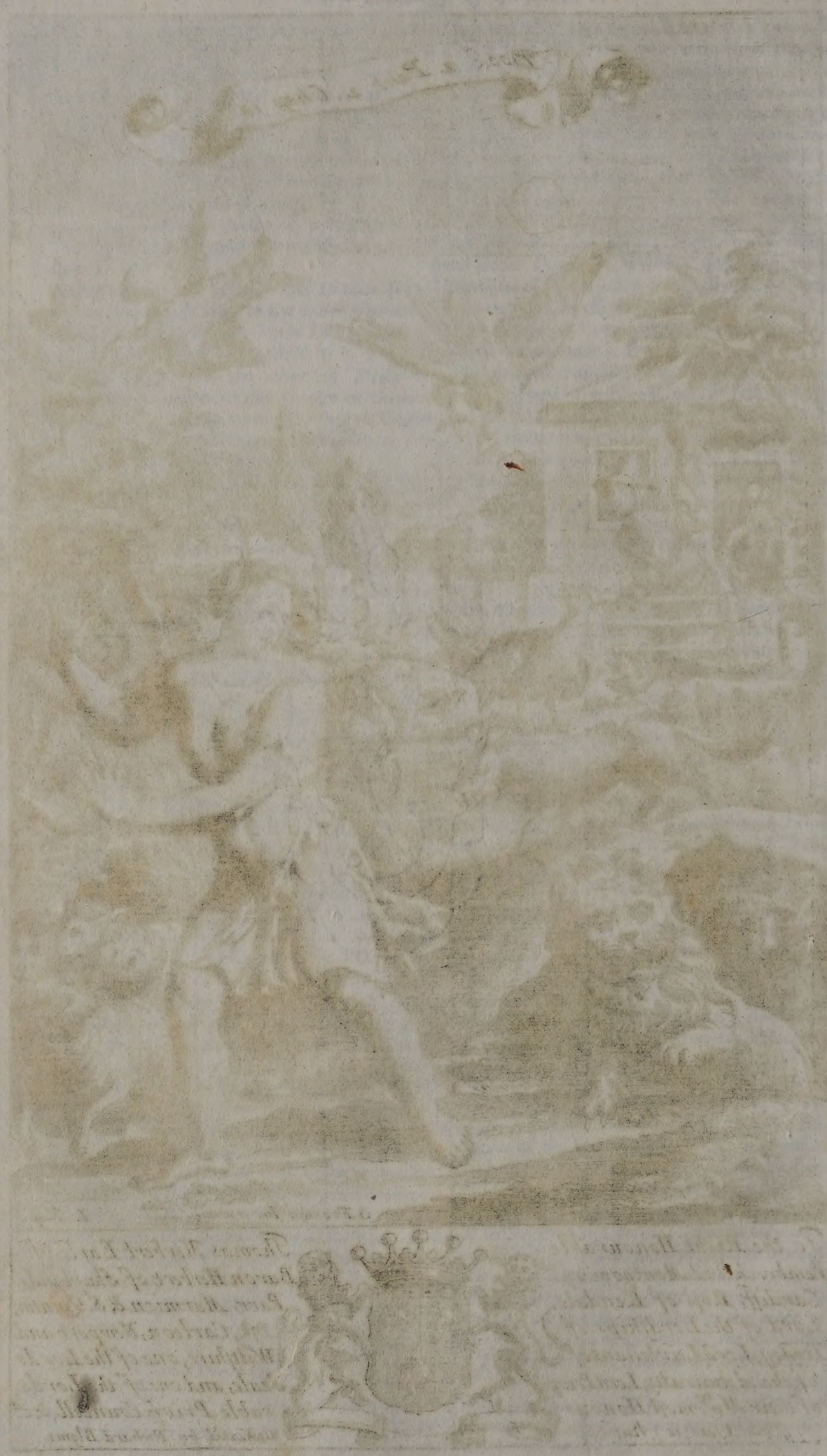
IV. *How water comes to mount upwards in Calcin'd Lead.*

For it cannot be queſtion'd, but that the *pores* of *New Bread*, how crooked or winding ſoever they may be, do much aſſiſt the aſcent of the *Liquor*: For they are as ſo many *Pipes*, through which the *water* leiſurely paſſeth, when it is preſſed by the external *Air*. Mr. BOYLE hath proved this by a like Experiment: For he took

G. Fremart Fec. I. Kip.

To the Right Honourable Thomas Herbert Earle of Pembrock and Montgomery, Baron Herbert of Shurland, Cardiff, Roß of Kendale, Parr, Marmion & S.r Quintin, Lord of the Lordships of Vsk, Carleon, Newport and Tredeg, Lord Leivtenant of Wiltshire, one of the Lords of the Admiralty, Lord Privy Seale, and one of the Lords of their Ma.ties most Honou= rable Privy Councell &c.a

This Plate is humbly Dedicated by Richard Blome.



took a long *Glaſs Pipe*, and fill'd it with *Red Lead*, and then put the lower end of the *Pipe* into the *water*, which by degrees mounted up the heighth of 40 *Fingers* breadths; by means of thoſe *pores*, which, like ſo many *Pipes*, do convey the *water* upwards.

V. *A Sheep flees from a Wolf, a Chick from a Kite, and a Pigeon from a Hawk.*

A *Sheep* trembles at the ſight of a *Wolf*; a *Chicken* at the ſight of a *Kite*; and the *Pigeon*, dreads the approach of a *Hawk*.

Philoſophers commonly attribute theſe Averſions to the mutual hatred that is between theſe *Creatures*; but without ſufficient ground. For a *Wolf* doth not hate a *Sheep*, but is delighted with it, and purſues it as a convenient Good for him. And the ſame may be ſaid of a *Kite*, that purſues a *Chicken*; and of a *Hawk*, that ſets upon a *Dove*. A *Sheep* therefore at the ſight of a *Wolf* betakes himſelf to *flight*, becauſe it is endued with ſuch a Texture of *Fibres*, that the *Light* reflected from the *Wolfs Body*, doth produce ſuch an affection, upon which the motion of running follows. For there are ſome *Rays* or *Spirits* which are continually darted from the *Wolfs Body*, which painfully affecting the thin *Fibres* of the *Sheeps Optick Nerves*, do ſuitably move the *Brain* and the *Spirits* contained therein, and convey them into the *Muſcles*, in ſuch a manner, as is neceſſary to put them upon a flight. For theſe *Spirits* are of a wonderful force to affect and agitate the *Body* which they puſh upon, and whoſe moſt inward parts they pierce into.

VI. *Whether any ſhade can be hurtful to the Body.*

Some *Shades* are commonly accounted to be of a hurtful nature, and to cauſe either Pain, or ſome other inconvenience. Thus a *Serpent* flees the ſhade of an *Aſh*. And thoſe who ſit down in ſhady places, are apt to be overtaken with ſleep.

Theſe Effects are not cauſed by the *Shade*, which being ſomewhat *Privative*, cannot have any poſitive Vertue or Effect; but from the ſteaming *current* of *particles* proceeding from *Bodies*, and more particularly from the neighbouring *Trees*, *Plants*, *Pools*, or any other *Bodies*. And that a perſon that ſits, or lies down in the Shade, is very ſuſceptive of theſe ſteaming *particles* that continually flow from *Bodies*, and very like to be affected by them, may be eaſily conceived, for that in *Summer-time* the *Pores* of the *Body* are more open, and ſtand ready to receive theſe outflowing little *Bodies*; and therefore no wonder if they be affected by them.

VII. *How Quickſilver kills Worms.*

Thus the Effects do prove that *ſubtil* and inviſible *Steams* do continually proceed from *Quickſilver*; for which Reaſon thoſe *Artificers*, who are much converſant about it, are uſed to keep *Gold* in their *Mouths*, with which they intercept the noxious *Steams* of the *Quickſilver*, which ſet themſelves about the *Gold*, and cleave to it, and diſcolour it. Moreover, *drops* of *Quickſilver* have been found in the *Heads* of theſe *Artificers*, and in other parts of their *Bodies*. For there are certain pure and *ſubtil Effluvia* or out-flowings, which proceed almoſt from all *Bodies*, which retain the Nature and Vertue of the *Body* whence they proceed. Neither is it to be doubted, but that *Quickſilver* boil'd in *Water*, doth communicate a Vertue to it, of *killing Worms*.

VIII. *There is no vertue in bare words.*

It is a common aſſertion amongſt the *Cabbaliſts*, that there is a great Vertue in Words; as by which, extraordinary Effects may be performed. And I remember to have read ſomewhere in *Paracelſus*, that upon pronouncing the words *Oſy, Oſya*, *Serpents* ſtop their motion, and lie ſtill as if they were dead.

But this is an ungrounded Opinion of the *Cabbaliſts*, foraſmuch as the *bare words* of the moſt worthy *Tongue* have no efficacy at all; no more than the *Vertue* of a *Man*, or the ſignification of ſome *Holy Thing*, can communicate any *Vertue* to the *Words* pronounced by the one, or importing the other. For tho' it cannot be denyed, but that *Orators* and *Poets* do excite *Paſſions* in the *Minds* of their *Auditors*; yet this is not by any hidden *Vertue* that is in their *Words*, but by the ſtrength of their *Reaſons*, and the aptneſs and *Muſical* cadence of their *words*. Wherefore what PLINY tells us in the *2d Chapter of his Natural Hiſtory* of the Preſervation of the *Fruits* of the *Earth* from harm, by ſome words *pronounced* over them, and of the *charming of Serpents*, ought to be lookt upon as *Fiction*. Seeing that *words* can operate nothing in a natural way, and have nothing of any *Sympathetical Connexion* with intelligences or the *Powers* of *Heaven*.

IX. *That a Noſe cut out of another mans fleſh, doth rot or periſh upon the death of that man.*

It is a common Story, that a *Noſe* cut out of the *Fleſh* of another *Man*, upon the *death* of him from whom it was taken, corrupts and rots as the *Body* of the *dead Perſon* doth. And the ſame is ſaid of the effect of the biting of a *Mad Dog*, which continues till the *Death* of the *Dog*, and then ceaſeth.

No ſufficient Reaſon can be given to verifie theſe *Effects*; and therefore I ſuppoſe that theſe things are reported by *Authors* without ſufficient faithfulneſs; or if any ſuch thing ever hapned, that it was an effect of chance, and not of any *Phyſical Cauſality*.

X. *Whether Wounds at a diſtance are curable by the Sympathetick Powder.*

It is alſo believed by many, that *wounds* at any diſtance may be healed by the *Sympathetical Powder*, by applying the *Powder* to the *Weapon* that made the *Wound*, or to a *Rag* that hath any of the *Blood* of the *Wound* upon it.

But tho' many great *Authors* maintain this for a truth, yet I am not eaſily perſuaded to confide therein. For we do not find in *calcined Vitriol*, which is the *Baſis* of that *Powder*, any thing conducive to the *healing* of *Wounds*, beſides an *adſtringent Vertue*, which is very proper to ſtop *Blood*, and to cloſe and heal a *Wound*. And tho' the *Spirits* proceeding from the *Vitriol*, may be ſuppoſed to exert ſome of their efficacy at a ſmall diſtance, yet is it not certain, that the *Power* thereof can be conveyed ſo far as is reported. Neither will the inſtances that are brought to prove this effect, be of any great weight with thoſe who conſider how apt the *Minds* of *Men* are to believe any ſtories, and how many do ſeem to take delight in being impoſed upon, rather than to be lookt upon as *incredulous*. So that it ſeems that theſe *Cures* ought rather to be attributed to the *cleanneſs* of the *Wounds*; ſince in the *Sympathetical Cure*, charge is always given to waſh them with *Urin*, which is endued with an abſterſive Power, by reaſon of the *Salt* that is contained therein. And this is no more than the *Dogs* themſelves do, who are uſed to cure their *wounds* by licking them.

But

XI. *By what means some may be cured by the Sympathetick Powder.*

But if *wounds*, at any time, have been cured with this *Powder*, the same must be performed by the *Effluvia* of little *Bodies*: Which tho' not always, yet very frequently retain the nature of those *Bodies* from whence they stream forth, and transmit the same to a vast distance; and by this means the *particles* proceeding from one *Body*, entring the *pores* of others, may there produce the same effect, and move the *Senses* much in the same manner as the said *Bodies* themselves would do by *Corporal Contact*.

XII. *Whence it is that that Twins are touched with the same affections.*

There is a great *Sympathy* observed between *Twins*; so that if one of them chance to be *sick* of any *disease*, the other is frequently seized with the same.

The Reason whereof is, because they both have the same *Texture* of their *Fibres*, and the same *Temperament* of *Humours*; so that if it happen, that if by any *distemper* of the *Air*, or by any hurtful *Meat* or *Drink*, the one of them falls *sick*, it cannot well be otherwise, but that the same effect must happen to the other, because of the great conformity of their Frame and Temper. And therefore it is that they are subject to the same motions of *Passions*; so that what produceth loathing in one, will effect it in the other; and whatsoever is desired by one, will also be desired by the other; because a like *Texture* receives the same affection from one and the same Object, and consequently stirs up the same *Appetite* and *Passion*.

XIII. *How some Old Women bewitch little Children.*

It is commonly said, that some *Old Women bewitch Infants*.

Which may be, because these *Old Women*, by the strength of their *Imagination*, intending their *Nerves* and *Muscles*, may dart forth from their *Eyes* some noxious *Spirits*, whereby the tender and easily susceptive *Body* of the *Infant* may be greatly prejudiced, especially if the *Infant* be near to the *Woman*. For *bewitching*, as PLINY tells us, *proceeds from the Spirits of the Witch, entring through the Eyes of the Bewitched, into their very Heart*. Indeed it seems probable enough, that by this darting forth of *Spirits*, much mischief may be done; since it is notorious, that a *Woman* that hath Those upon her, doth produce *Spots* and *Stains* in a *Looking-Glass*: And that one who *Coughs*, stirs up Coughing in others; and one that *Yawns*, a Yawning in him that sees him.

XIV. *Who are most obnoxious to Witchcraft.*

Whence we may understand the Reason, why all are not equally obnoxious to *Witchcraft* or Fascination, but only *Infants* and *Youth*, and others who have their *Pores* more open; and therefore are liable to suffer from the incursions of the *Spirits* and *effluvia* proceeding from others: Especially if the imagination of the *Witch* be heightned by *Love* or *Hatred*; because in this case they attack the party *bewitched* with greater force and violence. Wherefore care ought to be taken to keep little *Children* at a distance, and out of the sight of such *persons*.

XV. *How a Scorpion applied to the place stung by him, draws out the Poison.*

A *Spider* or *Scorpion* that hath bit or stung a *person*, being bruised, and applied to the part affected, draws out the *poison*.

The Reason is, because the substance of a *Spider* or *Scorpion* is like a *Sponge*; which, whilst the parts that are sever'd by the contusion, shrink by means of the *Nerves*, do take up the adhering *venom*, and draw away that which is got in. For this is effected much in the same manner, as *Oyl* is washed out of a *Cloath* by means of *Soap*; for as the *particles* of *Oyl* which are got into the *Cloath*, do easily embrace those of the *Soap*, as being of a like nature, and are carried away with them: So the *particles* of the *Poison* sticking to the *wound*, do easily join themselves with those that are found in the bruised *Animal* applied to it, and by this means the *wound* is freed of them.

XVI. *Whence it is that some Stones perform the like effects.*

KIRCHER tells us, that in *China* there be many *Serpents*, which are called by the *Portugueze Hat-bearers*, because they have a *Skin* that starts up on their Heads, not much unlike a *Hat*, in which little *stones* are found, which being reduced to *Powder*, and mixed with *Terra Sigillata*, and applied to a *poisonous wound*, stick fast to it and draw out all the *Poison*, and then fall off from the *wound* of themselves, which are afterward washed clean in *Milk*, in order to be used again as before. For indeed most *poisons* are better overcome by *Alexipharmacs*, than by *Vomits* or *Purges*.

XVII. *Whether a Wolf causeth a Hoarseness in those whom he sees first.*

It is commonly believed, that a *Man* who is seen of a *Wolf* before he sees him, grows *dumb*, and is unable to utter a *word*, or make the least noise.

Tho' this be an old Story, yet there appears no ground at all for it: Seeing that Experience teacheth, that whether a *Wolf* see a *Man* first, or or whether a *Man* see the *Wolf*, the same commotion or disturbance follows. I my self have very often lookt upon *Wolves*, yet never perceived thereby any Hoarseness, or the least defect in my *Voice*; but on the contrary, have many times by my shouting, made them run away. But how does it come to pass then, that some persons at the sight of a *Wolf* do contract a *Hoarseness*, and become *Dumb* of a suddain? Why this proceeds only from *Fear*, when the great concern they either have for their own *lives*, or for the safety of their *Company*, puts them into a suddain consternation; for then endeavouring suddainly to cry out for help, they hurt their *Lungs* by the great force put upon them, and the *Wind Pipe* by fetching in of too much breath, becomes, as it were, choaked. To which may be added, that the *Muscles* of the *Tongue* being slackned, by the great defect of *Spirits*, cannot readily be made use of, for the forming of the *voice*. So that by the failing of all these Instruments, it cannot be otherwise but that a *Hoarseness* must be caused, and the *Tongue* disabled from uttering an articulate sound.

XVIII. *What is the Reason of the Antipathy which is found amongst Plants.*

Some *Plants* have an *Antipathy* against each other; as the *Oak* and the *Olive Tree*, *Cabbage* and *Rue*, *Fern* and *Reed*, which cannot endure the neighbouring of each other, nor can touch one another without some prejudice.

The Reason of this *hatred* is, because these *Plants* are desirous of one and the same *Alimental Juice*; and therefore the stronger of them doth draw all that juice to it self, and by this means robs the weaker of its necessary *food*, which must needs hinder it from growing and thriving as otherwise it would. Or else we may say that *Plants* set near one another, may hinder each others growth, in that the emanations or effluvia which

which proceed from their *Roots*, may be noxious to each other. For the *Olive Tree* communicates such a bitterness to the ground round about it, that it spoils the *Cabbage* and *Lettice* that grows near it. And *Fern* hinders the growth of *Reeds* by the steams proceeding from it, which obstructs their *Pores*, and disturbs the *Texture* of their *Fibres*.

XIX. *What the Reason is of the Sun-flower turning towards the Sun.*

The *Heliotrope* or *Sun-flowers*, always turns it self towards the *Sun*, and doth so follow its motion, as to face it continually. *Theophrastus* makes mention of some of these *Heliotropick* Plants, growing about the River *Euphrates*, which at the *going down* of the Sun, do so drop their Heads and Flowers into the *River*, that they cannot be reached with the Hand; but as soon as the *Sun* riseth, lift them up again to their former height.

This, I suppose happens, because that *Plant* abounds with much and *gross moisture*, which being agitated by the *Beams* of the *Sun*, and thereby rarefied, cannot be contained within the same *bounds*, and therefore strives to make its way through the most open Pores, that is, those which are over against the *Sun*: and forasmuch as the *Neck* of this *Plant* is very plyable, the agitated moisture which breaks forth from it in the finest *Threds*, turns it self that way towards which the *particles* of the moisture tend. The extraordinary *moisture* of this *Flower* may be confirmed from that *Dew* which lies upon the midst of it, when the *Sun* is at the highest and hottest; which cannot be said to be the remainders of the morning *Dew*; forasmuch as that vanisheth a few hours after the *Sun Rising*; and therefore must be that *humour*, which upon the presence of the *Sun*, doth flow from its Stalk, and is carried up to the *Flower*.

XX. *The Explication of a wonderful Sundial.*

In like manner a reason also may be given of that admirable *Dial*, invented by *F. Linus* at *Liege*, whereby a little *Ball*, *swimming* upon the *water*, did shew the *hours*, and exactly *imitate* the motion of *Heaven*, after the Example of KIRCHER, who having put some *Seeds* of the *Sun-flower* into a *piece* of *Cork*, found that they turned the *Cork* towards the *Sun*, and that by fixing a hand to it, they exactly pointed out the *hours* placed round the inside of the *Vessel*. For seeing that the *Sun-flower* is turned towards the *Sun*, not only *Eastward*, but *VVestward* also, it must needs point to the *hours* noted on the sides of the *Vessel*.

XXI. *VVhether the Bones of Animals, and Shell-fish be fuller at full Moon, than in the wane of it.*

The *Bones* of *Animals* are filled with *Marrow* at the full *Moon*; and *Crabs* at the same time do more abound with *flesh*; whereas in the wane of the *Moon* both are decreased.

These Effects, tho' commonly asserted to be so, yet many most exact observers of the works of Nature testifie, they could never discern in either of these any such encrease or decrease, but that the *Bones* of *Animals*, as also Shell-fish at any time of the *Moon* are promiscuously found either full or empty, or more or less fleshy, according as it may happen from other *accidental Causes*.

XXII. *Why Crabs and Lobsters are more full of flesh at one time than another.*

So that if at any time it happen that *Crabs*, *Lobsters* or *Oysters* be found more full of *flesh* at one time than at another; the reason is, because they have then met with more plentiful *Aliment*: For we find that of *Fishes* that are taken at the same time, and in the same place, some are much fuller of *flesh* and fatter than others; and that those Fish which are taken out of the *Nets*, as soon as they are caught, are fuller of *flesh*, than those which are left in the Net a good while before that they be taken out.

XXIII. *VVhy the Skin of a Stag swims above all other Skins.*

The Skin of a *Stag*, if it be put by *Tanners* at the bottom of their Fat, and the *Hides* of other *Beasts* laid upon it, as soon as *water* is poured into it, never rests till it have got above them all, at the top of the *Tanning Pit*.

GASSENDUS imputes the cause hereof to the wider *cavity* of the *Stags Hairs* (for the *Microscope* assures us, that the *Hairs* of *Animals* are all of them so many hollow *Pipes*) which being filled with *Air*, endeavour to get above the *water*, as a *Bladder* full of *Air* doth. He supposeth also, that this is a great help and furtherance to the swiftness of that *Animal*, because the said *Pipes* being dilated by the heat of the motion of the *Stag*, doth much contribute to their *Lightness*: as it is also very probable, that the *Quill* part of the Feathers of *Birds* are a great help to their being easily supported in the *Air*.

XXIV. *VVhy Persons bit of the Tarantula, do skip and dance.*

They who are bit by the *Tarantula*, are so delighted with some certain *Tunes*, as to be thereby stirred up to strong and continual *Dancing*.

The Reason whereof is, because the *poison* of the *Tarantula* doth alter the Temperament of the *Body*, and particularly so affect the *Organ* of *Hearing*, as to comport with those *Tunes*, wherewith that *Insect* is delighted. For as there are several sorts of these *Tarantulæ*, whereof some are affected with these *Tunes*, some with others; so that as the *Piper* or *Fidler* plays these, or the other Notes, so these, or other of their *Insects* begin to frisk, and cease as soon as ever the *Tune* is done. Accordingly it seems, that the *venom* of these *Insects*, being diffused through the *Body* of *Man*, and mingled with the *Spirits*, and afterwards excited by such *notes*, is moved after the same manner, and also impresseth the same motions on the *Spirits*, which by means of the *Nerves* and *Muscles*, produce a *Dancing*, corresponding with such *notes*. And this is the Cause of the recovery of him that is bit, because by this quick motion, the *poison* is discust and exhaled together with the *Sweat*, provoked on this occasion.

XXV. *How Medicaments do purge.*

Some *Medicaments* do *purge* by their *smell* only; others by being handled, or applied to the *Navel*.

The Reason is, because the *odour* only of a *Medicament* doth as strongly affect the *Nerves*, as they are affected by it, when taken inwardly; that is, when the *Fibres* or *Strings* of the *Stomach* and *Guts* are twinged and vellicated after the same manner, as they are when the *Medicin* is swallowed down into the *Stomach*. For the parts of *Medicaments* are commonly very small and sharp, hard, swiftly agitated, and very penetrative; so as that by this means they do irritate and excite the *Membranous* and *Nervous* parts of the *Body*, and provoke them to *expulsion*. Whence we may conclude, that almost all the properties and *virtues* of *Medicaments*, which are commonly added to the *Catalogue* of occult *Qualities*, may be explained and resolved by *mechanical Principles* and *Affections*, whether they produce these effects, by a likeness, *analogy* and familiarity of Nature, or whether they exert this their efficacy by way of irritation.

The Third Part
OF THE
HISTORY
OF
NATURE.
OF THE
WORLD,
AND
HEAVEN.

CHAP. I.

Of the Beginning of the World.

I. *The Opinion of* Ariſtotle *and* Epicurus, *concerning the Worlds Original.*

THO' we be ſufficiently aſſured by *Revelation*, concerning the *Worlds Original*; yet it will not be altogether uſeleſs, to ſee what *Reaſon* can ſay in the caſe, and whether by her conduct we may not be able to diſcover the *Beginning* thereof. ARISTOTLE maintains the *World* to have exiſted from *Eternity*, in his VIIIth *Book of the Phyſicks*, and in his 1*ſt of Heaven*, where he endeavours to prove *Motion* to be from Eternity, and that no *temporal Principle* of *Motion* can be admitted. To which he adds alſo, that it is no way agreeable to the *Firſt Cauſe*, to be *Idle*; and that therefore we muſt of neceſſity own, that there muſt have been ſomething *moveable* from all *Eternity*. And as for EPICURUS, he makes *Matter* to be *Eternal*, but the *World*, *Temporary*, and proceeding from the fortuitous concourſe of *Atoms*; whereof LUCRETIUS treats in his 4*th Book of the Nature of things.*

II. *The Opinion of* Plato.

The chiefeſt amongſt the *Ancients*, that attributed a *Beginning* to the *World*, was the *Divine* PLATO, who tho' he acknowledgeth it to have been begot from *Eternity*, yet aſſerts it to have proceeded from GOD by a kind of Emanation, as the *Sun-beams* from the *Sun*. And ſurely he very well deſerv'd his Name, foraſmuch as from the Contemplation of *Created Things*, he diſcovered the *Maker* of them; and from the nature of *Effects*, raiſed himſelf to a view of the Efficiency of the *Supream Cauſe*. But let us hear him diſcourſing the Point in his TIMÆUS: *The Univerſe*, ſaith he, *is ſeen, felt, and hath a Body; all which things move the Senſes, and thoſe things which move the Senſes, are known or diſcerned by the Senſes. Now it is apparent, that ſuch things as theſe are of that nature as to be generable and generated; but whatſoever is generated, we aſſert muſt be generated by ſome Cauſe. It is a thing of difficulty indeed to find out the Maker and Father of this World; and after that you have diſcovered him, to declare him to the Common People.*

III. *The Diſpoſition of the Parts of the World, proves the Maker of it.*

Indeed there is nothing in the *Univerſe*, which doth not preach the *Creatour* of it; nor doth *Nature* repreſent any thing to the *Eyes* of *Men*, which doth not ſpeak its *Author*, and excite us to adore and praiſe him. Who is there, that by the Diſpoſition of the *Parts* of the *World*, is not forced to own its *Orignal*, and to confeſs that it is not *Eternal*? Shall we imagine that all theſe things, as EPICURUS will have it, were the effect of blind *Chance*, and that it ſtumbled upon all theſe curious aud beautiful *Effects* we do admire? Were the *Earth*, the *Heavens*, the *Stars* their own *Cauſes*, and ſtated in that neceſſary and comly Order, without the Deliberation of a *Contriver*? What *virtue* or *force* is there in *Atoms*? What *power* in *Matter*, towards the production of a *World*, beautified with ſuch an infinite variety of *Wonders*? Or, if theſe *Atoms* were the Framers of the *Sun*, *Earth* and *Planets*; why did not theſe blind and ſtupid *Artificers*, jumble themſelves as well into *Cities*, *Houſes*, *Churches*, and *Piazza's* for us? Since theſe are Inſtances of a more eaſie and obvious *Artifice*, and ſuch as human Induſtry can furniſh.

IV. *The Fabrick of the World proclaims its Maker.*

An *Engin* curiouſly and acurately wrought, bears the ſtamp of the *Artificer* upon it, and is an inconteſtable Demonſtration of his Ability and Skill. But what *Machin* is there in the leaſt degree comparable with this raviſhing frame of the *Univerſe*? In which, nothing is dull or idle; nothing produced at a venture, or in vain. Conſider the *Vegetables*, they have all of them their peculiar

virtues.

To the Right Honourable
John Cæcill, Earle of Exeter,
Baron Cæcill of Burleigh &c.[a]

This Plate is humbly Dedicated by Richard Blome.

virtues. Take a view of the *Animals*, they have all their particular *Natures*, and ſeveral propenſions. Mount up to *Heaven*, and there behold the *Stars*, ſo exquiſitly ranged, performing their *motions* with ſo much ſteadineſs and equability, and always keeping within the bounds of unchangeable Viciſſitudes. *No man can be ſo ſenſleſs,* ſaith MERCURIUS TRISMEGISTUS, *to affirm, that a Portraiture or Statue, can be made without a Painter or Statuary: And will you ſay, that this Great Work had no Maker? O Blindneſs beyond compare!*

V. *The Parts of the World being Corruptible, conſtitute the whole ſo.* The *Whole* is of the ſame nature as its *Parts*, as being the reſult of them, and deriving its *diſtinction* from their Diverſity. Now nothing is more notorious, than that the Parts whereof the *World* is compoſed, are ſubject to *Riſe* and *Fall*, to *Generation* and *Corruption*. The *Earth* is nothing elſe, but a great *Theater*, where theſe Changes are continually repreſented, and which, according to the different Viciſſitudes of Time, is differently dreſt and mark'd. The *Fire* periſheth daily, and that which ſeems of ſuch inſuperable Force, vaniſheth in a moment. *Water* is ſuckt out of dry *Bodies*, and by its motion wherewith it penetrates *Bodies*, becomes turned into *Flowers* and *Graſs*. Nothing in the *World* is of any long continuance; and it is a clear Demonſtration, that that had a *beginning* of its being, which is continually haſting to its *end*.

VI. *An Objection.* Some endeavour to avoid the dint of this *Argument*, by ſaying that *Generation* and *Corruption* are incident indeed to the Parts of the *World*; but that nothing hinders, but that the *Whole* may continue for all this for ever; foraſmuch as the Total Sum continues ſtill the ſame, and is only changed as to ſome *Externals*, much in the ſame manner as *Wax*, by admitting the various impreſſions of *Seals*, only changeth its *figure*, ſtill retaining its *ſubſtance* unalter'd.

VII. *Anſwer.* We readily grant them, that no other Change happens to this *World*, but what is *Accidentary*; yet can it not be concluded from thence, that the *Whole* is capable of being diſſolved. For if one or the other Part may periſh, why not 20, or 100, or 1000, nay, all of them; ſince we find various Deſtructions hapning in divers *places*, and that many things are oft ruin'd in one *day*, which had continued untoucht for many *Ages*? And tho', it may be, theſe things may not be very frequent, and have the Intervals of many *Years* between them; yet cannot we thence infer, that they can't happen: Seeing that many things throng in upon the *World* at one time, which have been unknown and unheard of for many *Ages*. The Inſtance of the *Wax* is nothing to the purpoſe, whoſe Change is only outward: For the *World* is capable of thoſe Inteſtine *motions*, which one day or other will be the overthrow of it. Do not we daily ſee New things ſtart up, and Old things ſinking and periſhing? We have therefore good reaſon to conclude, that as we ſee that Changes happen to the Parts of the *World*, ſo the *whole* is obnoxious to the ſame alterations and perturbations. Hence LUCAN, in his *Firſt Book*:

One Common Fun'ral-Pile the World ſhall burn,
Mix Bones with Stars, and all to ruin turn.

But foraſmuch as our deſign here is, to ſet down an *Hiſtory of Nature*, we will endeavour to derive the *Original* of the *World* from the *Monuments* of the *Ancients*. We have no *Hiſtory* that gives us any account of things that paſſed before the *Theban* and *Trojan War*. But if the *World* be *Eternal*, and conſequently without all *Beginning*, how could it be that the *Hiſtorians* and *Poets* of fore-going *Ages* ſhould not have deliver'd to us the *Deeds* of the *Heroes* of their Times, which they atchieved during ſuch immenſe Spaces of Time, or the *Laws* enacted by *Legiſlators*? Wherefore ſince nothing of theſe is any where to be found, it affords us a tacit *Argument*, that the *World* was *Created*, and had its *beginning* not long before thoſe Times.

VIII. *Hiſtory bears witneſs to the Beginning of the World.*

IX. *The ſame proved from the Inventors of things.* Beſides, who will ſay, that the *VVorld* hath been from *Eternity*, when as, beſides the *Teſtimony* of *Hiſtorians*, the Improvement and Invention of *Things* and *Arts*, ſhew it to be of no over long ſtanding? For the account which the *Ancients* give us of *Men*, is, that they liv'd after a *Barbarous manner*, not much different from that of *Beaſts*; and that they did not Feed, as we do now-a-days, but maintain'd their Lives in the open *Woods* and *Fields*, with *Acorns* and *Berries*, as MACROBIUS tells us; and that it was not till long after, that they began to *Till* the *Ground*. Beſides, is not this a ſtrong *Argument* for the proof of the *Non-Eternity* of the *VVorld*, that the *Greek Hiſtory* it ſelf doth not make mention of any Matter of Fact, beyond the Space of 2000 *Years*, there being nothing memorable related in *Hiſtory* before NINUS, who was the Father of SEMIRAMIS. Now if the *World* was from *Eternity*, why were not all things highly improved, during that vaſt Viciſſitude of innumerable *Ages*? Or, how comes it to paſs, that New things are yet Invented? All theſe things are ſtrong *Arguments* againſt the *Eternity* of the *VVorld*, and give us great Reaſon to ſuppoſe, that as the *VVorld* had its Beginning; ſo all things in ſucceſſive Years were Invented, Cultivated, and Improved.

X. *The Eternity of GOD doth not prove the Eternity of the World.* Neither are we pinch'd by that Objection which is commonly made by the *Platoniſts*, that nothing hinders, but that the *VVorld* might have been produc'd from *Eternity*; ſeeing it is not repugnant for ſome Effects to be coexiſtent with the Principle of their *Emanation*. For the *Queſtion* here is not, Whether the *VVorld* might not have been *Eternal*, and Coexiſtent with its *Creatour*; but whether it be really ſo? Since it is evident, that GOD doth not act of Neceſſity, but freely and ſpontaneouſly, after the ſame manner as a *Workman* is the Cauſe of his *VVork*. For tho' the *Idea* of the *VVorld* be granted to be from *Eternity* in the Mind of GOD; yet doth it not follow from thence, that the Work made by it is *Eternal* alſo, except we ſhould affirm, that the thing conceived is inſeparable from the perception of it; and that a *Houſe* is built, as ſoon as the *Architect* hath conceiv'd the *Draught* of it in his Mind.

XI. *Arts prove the World, not to be of any long ſtanding.* *Arts* alſo prove the *Beginning* of the *VVorld*; ſeeing that moſt of them can be traced up to their firſt *Inventors*, and that not through any vaſt Interval of Time. For we know who firſt Invented the *Plough*; who furniſh'd Men with the uſe of *Iron*, for the deſtruction of their own kind:

Who

who first taught the *Art of Fencing*; who, that of *Dancing*. But if the *VVorld* never had any *Beginning*, why were not *Things* and *Arts* improved many Ages ago to the same height, and beyond what they are now? How came it to pass, that the *Art of Printing* hath been so lately known in the *VVorld?* What was the Reason that *Vines* were no sooner *planted*; and that *Olive-Trees*, for the succession of innumerable *Ages*, were banisht from the *Fields?* What can be imagin'd the Reason, why the *Mariners Compass* was not found out till near our *Days*, which is of that use to us for the *Crossing* of the *Seas*, and towards the discovery of New-found *Lands* and *Men?* All these *Instances* plainly overthrow the *VVorlds Eternity*, and prove it not to be of any very long standing. Which made LUCRETIUS say,

——the VVorld is new,
Nor can it many Ages of its standing shew.

XII. *What time of the year the VVorld was made.*

It is a thing controverted amongst *Authors*, about what time of the *year* the *VVorld* was made; some allowing this advantage to the *Spring*, and others to the *Autumn*. Tho' indeed I can see no Reason at all, why either of these *Seasons* should be preferred before the other; seeing that both continually reign in one part or other of the *VVorld*. Moreover, it seems absur'd to determine the *Beginning* of the *VVorld* to one *Season* of the *year*, forasmuch as all the 4 are found in it. But if this *Question* be meant of that part of the *VVorld* where GOD at first *Created Man*, and where *Men* first inhabited, it seems probable that the *VVorld* was *Created* at the time when it was *Autumn* there; seeing that it is most agreeable to Reason, that all things were *Created* by GOD, and that nothing is made by him, but what is most absolute and perfect in all degees.

CHAP. II.

Of the Creation of Things, and of the Ranging of the several parts of the World.

I. *The Creation of Heaven and Earth, as it is described by* Moses.

MOSES, whose *History* is owned not only by *Modern Philosophers*, but by the *Ancients* also, in the *1st Chapter of Genesis*, describes at large the *Creation* of the *VVorld*, beginning with the production of *Heaven* and *Earth*, in which two, as the *Center* and *Circumference*, he comprehended the whole *Universe: In the Beginning*, saith he, GOD *created the Heaven and the Earth*: But the *Earth* which was cover'd with the *water*, and involved in Darkness, *was empty and void*. For the *Spirit*, or *Subtil Matter*, did lye upon the whole *Mass* of the *Earth*, to excite and stir up its sluggish consistence; yet because it was only moved in a huddle, and without any certain determinate *motion*, the *Earth* all this while continued *void*, that is, Invisible, until by the Commanding word of the *Almighty*, *Light was made*, which might distinguish the *Times*, and discover the distinct appearance of all things in their several *places*.

II. *How GOD at first moved the Created Matter.*

For we are to suppose, that GOD having Created this *Immense*, *Extended Substance*, which fills the the *Length*, *Breadth* and *Depth* of the *VVorld*, he divided the same into infinite *Parts*, some of one *figure*, and others of another; some *greater*, others less; and that this Variety is much greater than our *Spirits* can reach. We are also to conceive, that GOD, in dividing the Parts of the *VVorld*, hath not left any *void Spaces* between them; but that all the difference or division he hath made between them, consists in the diversity of their *motion*, which he hath given to every one of them; ordering it so, that from the very first instant of their *motion*, some of them began to move one way, and other another: To which if we add this, that the Parts of the *Matter* are impenetrable, it will appear evidently, that GOD could not continue to move them, without causing an infinite Variety in their *motion*, until at last they all agreed to move about different *Centers*, and consequently to constitute divers *Vortices* or *VVhirlpools*.

III. *How Stars came to be formed in the Center of every Vortex.*

And forasmuch as all *Bodies* that move *Circularly*, do continually endeavour to withdraw from the *Center* of their *motion*; and that the strongest always withdraw themselves further than the weaker, it follows of necessity that the *Matter* of the *Second Element*, which is more strong than that of the *First*, as being more solid, must withdraw themselves further from the said *Center* of their *motion*; and that in this their withdrawing, they drive downwards to the *Center* those *Particles* of the *First Element*, that are more than are necessary to fill the Spaces, which the *Particles* of the *2d Element* leave open between them. Whence it follows, that about the *Axis* of each *Vortex*, there must of necessity be a *Body* which is only composed of the *Matter* of the *First Element*, which every way pusheth the *Second Element*, that surrounds it, and pusheth it with Force enough, to have the *motion* transmitted, almost in an instant, at certain Distances. And it is in this pression of this *Subtil Matter*, which is at the *Center* of each *Vortex*, and which endeavours to withdraw from it, that that *Light* doth consist which appeared the first Day of the *Creation*.

IV. *The First Days work.*

But forasmuch as at the *Beginning*, there was not any great store of the *Subtil Matter* in the *Centers* of the *Vortexes*, the *Action* wherewith the *Globuli* were pressed, could not reach far; and therefore those Spaces to which the Effect of that Action could not reach, continued obscure, and cover'd with *Darkness*.

And accordingly, by this mixture of *Light* and *Darkness*, the *World* became distinguisht into several *Provinces*, and by the penetration of the *Subtil Matter* through all *Bodies*, the thinner and more subtil Parts were distinguisht from the more thick and gross, and the *light* from the *heavy*. And this was the Work of the *First day*, and an Argument of the *Omnipotence* of the *First Being*. For nothing was produc'd anew the following *days*, but the things already made were ranged and order'd, and a proper place assigned to every *Body*.

V. *How the Vortexes were formed.*

And forasmuch as GOD could not move the *parts* of *Matter* with different or opposite determinations, without making them to hit directly or indirectly against one another, those which run against one another indirectly, must of necessity be reflected different ways, by *Angles* of *Reflexion* equal to those of their incidence: But they could

could not so reflect themselves, without meeting with other Parts, which turned them aside in like manner: So that meeting with a 2*d* repulse, and afterward with a 3*d*, 4*th*, and so on, they were at last forced to move about different *Centers*, somewhat in the same manner as the *water* of a *River*, is forced to move so, when it meets with new stops in its way; and thus made up several *Vortexes*, differently situated with respect to each other.

VI. *The Second Days work.* On the 2*d Day*, after that a *Firmament* was interpos'd betwixt the *Waters*, some of them had a place allotted above it, others under it, to *water* the surface of the *Earth*, and for the generating and feeding of *Fish*. For if we enquire into the *Etymology* of *Firmament*, we shall find it to signifie no more than a great and *diffused Extension*, which we suppose to be nothing else, but the Disposition of the *Vortexes*, by means whereof they became so ranged, as that the *Ecliptick* of one *Vortex*, did answer to the *Poles* of its Neighbouring *Vortexes*, by which means they were so far from hindring the *motion* of each other, that they rather promoted the same. Whilst therefore the *Heavenly Matter* did continually run through these vast Bodies, *the waters became divided from the waters*; and those which covered the *Earth*, by the portion of the *Firmament*, were separated at a vast distance from those other *waters* which did lye upon solid and thick *Bodies*. And consequently, *the waters that were under the Firmament, were divided from the waters that were above the Firmament*. For it is evident, that *Moses* calls the *Heavenly Bodies*, Upper or Superiour; and the *Earth*, Inferiour or Beneath, with respect to us.

VII. *The Third Days work.* On the 3*d Day*, the *waters were gathered into one place, and the dry Land appeared*; because when the *Earth* was wholly cover'd with *water*, so as that no part of it did appear, it seemed good to the *Author* of *Nature*, to gather the *waters* into some certain places, to the end that the *Surface* of the *Earth* being freed from them, might bring forth *Grass*, *Herbs* and *Trees*, from those several *Juices*, which running through the *Bowels* of the *Earth*, were joyned to divers *Seeds*, whose *pores* suited best with the *figures* of them. Whereupon the *Earth* was called the *Dry Land*; and the gathering together of the *waters* was called, *Sea*. But forasmuch as the *Roundness* of the *Earth* did hinder the *water* from running into one place, and that there was no Cavity sufficient to receive that immense Heap of *waters*, we are to believe that the *Mountains* were *created* on the same Day, and other Rising parts of the *Earth*, which leaving deep *Vallies* between them, made way for the Reception of the *waters*.

VIII. *The Fourth Days work.* The *Matter* of the *VVorld* being thus orderly ranged, the next work was to adorn the same: For on the 4*th Day*, 2 *Great Lights* were placed in the *Firmament* of *Heaven*, that they might be for *times, days and years*; that is, that by them the *Diurnal* and *Annual Circumvolution* of the *Earth*, and the other *Planets*, as likewise the *Circumvolutions* of the *Sun*, might be known and determined. At the same time there were also *created* many *Stars*, having a Light of their own, which they dart abroad every way.

For seeing that the *Matter* of the *First Element* did continually increase, by means of the *motion* of the *particles* of the *Second*, and that there was a greater quantity of it in the *Universe* than was necessary, to fill those Spaces that are left betwixt the *Globuli*; all the remainder of it, after that those Spaces were filled, run to the *Centers* of the *Vortexes*, where it composed some most *fluid Spherical Bodies*, *viz.* the *Sun* and the *fixt Stars*. For after that the *particles* of the 2*d Element* were still more worn away, they took up less place than they did before, and consequently did not diffuse themselves quite to the *Centers*; but equally drawing from them, left their *Spherical Spaces*, which were filled with the *Matter* of the *First Element*, flowing thither from all parts. And therefore the collection of the *Subtil Matter*, in the *Center* of our *Vortex*, in which the *Earth* is, with respect to it, was the *Greater Light*, or the *Sun*; and the Collections in the *Centers* of the other *Vortexes*, *Stars*: And that *Matter*, which of those great *Masses* which approached near to the *Earth*, was found most fit to drive the *Light* of the *Sun* towards it, became *the lesser Light*, that is, the *Moon*.

IX. *The work of the Fifth day.* On the 5*th Day*, GOD commanded the *waters* to bring forth *Living Creatures*, and the *Fowl* that fly above the *Earth*, in the *Firmament* of *Heaven*: And the *Creeping things* also, which without *Feet* crawl upon the *Earth*. And tho' the *Scripture* seems to attribute to *Fishes* and other *Beasts*, a *Soul*, produc'd out of the *VVater* and *Earth*; yet nothing else is to be understood there by the word *Soul*, but only some *Bodies* in such a manner fitted and adapted to the *Organs* of *Fishes*, and other *Animals*, that they cause them to *live*, to *feed* and *grow*.

X. *The Sixth Days work.* Lastly, After that the *House* was now perfected, and the *Palace* fully furnish'd and adorn'd for the reception of its great *Guest*, the *Little-VVorld* enter'd the *Greater*, being endued with *Life*, *Sense* and *Reason*; that he might be the *Lord* and *Commander* of the *Universe*, to whom the *Fishes* of the *Sea*, the *Birds* of the *Air*, and all the other *Living Creatures* of the *Earth*, might pay their *Homage* and *Obedience*. These things thus order'd, GOD made an end of the Works he had made.

This *Creation* of the *VVorld* hath, by DANÆUS, been comprehended in short Verses, in his *Christian Natural Philosophy*; which in *English* speak thus:

The First Day made the Heavens, the Earth, and
Light:
The Second, brought the Firmament in sight:

The Third, gave the Sea Bounds, and Grass to
th' Earth:
The Fourth, to Sun and Moon, and Stars gave
Birth:
The Fifth, made Fish o'th' Sea, and Birds o'th'
Air:
The Sixth, gave Beasts, and Man, GOD's
chiefest Care:
The Seventh, and last, appointed was for Rest.

XI. *Why the World was Created in the time of Six Days.*

We need not here insist upon the Opinion of some of the *Jews*, who do not think it probable that the *World* was *Created* in 6 *Days*; and therefore do suppose, that this determination of *Days*, is to be taken *Allegorically*: To which some of the Ancient *Fathers* have been inclin'd; forasmuch as *GOD*, in *Creating* of the *World*, did not proceed in such a manner, as absolutely he might have done, but in such a manner as may be best understood and apprehended by us *Mortals*. For he ordered the *Creation* thus, that we *weak Men* might know, that he *works* nothing without the greatest exactness and order; because we are not able to conceive, how any Order could be observed in a simultaneous *Creation*.

CHAP. III.

Of the End or Destruction of the World.

I. *Whatsoever hath had a beginning, must of necessity have an End also.*

FRom what hath been said, it is evident that the *World* was *Created*, and that those things that had a *Beginning*, are subject to Corruption and Dissolution. For why may not we attribute a Principle of *Destruction* to that, which we own to have had one of *Production*; and suppose that that which once began to be, will meet with a time wherein it must cease to be? For is not the *Matter*, whereof the whole *Universe* doth consist; the Original and Cause of *Dissolution*? And do not all things that we see, decay daily, and hasten to their End?

For he seems to be but little acquainted with *Natural Philosophy*, who supposeth that to be *Eternal* which hath had a Beginning, as VELLEJUS saith, according to the Opinion of PLATO, as CICERO sets it down in his *1st Book de Natura Deorum*. For where can we find a thing put together, that is not subject to be taken in pieces again? Or, where is that thing which hath *Beginning*, and shall not have an *End*? And accordingly LUCRETIUS tells us, in his *First Book*.

As Beasts depriv'd of Food, so things must die,
As soon as Matter fails of just supply.

II. *The Opinion of the Ancients, concerning the Duration of the World.*

But you will say, that there have not been wanting some *Philosophers* who have attributed *Eternity* to the *World*, and have conceived this Great *Fabrick* so admirably contriv'd and built, as not to be capable of Dissolution. Which Opinion hath been maintain'd by ZENOPHANES, MELISSUS, ARISTOTLE, and others, who accused those of Impiety, who maintain'd, that the *World* would perish. Neither were PLATO and PYTHAGORAS Enemies to this Opinion: For tho' they believed that the *World* would have an *End*; yet withal they supposed, that *GOD* only was to be the Dissolver of it; as thinking it unbecoming him, to make a *Work* that should be dissolvable by any other Hand than his own. That it is the property of *Parents*, to desire the preservation of their *Offspring*, and by no means to desire their *Destruction*.

But these are the *Judgments* of Blind-men, who without having a due regard to the Constitution of the *World*, thought the parts thereof to be joyned together by such strong Ties, which no Ages could be able to dissolve. But to oppose *Authority* to *Authority*, were not the *Epicureans* and *Stoicks* of another Opinion? The latter of whom supposed nothing to be *Immortal*, but *Jupiter* alone, and asserted that the *Earth*, *Sea*, *Air* and *Heaven*, were all to have an End, and to be changed into other *Bodies*; as the *Tragical Poet* seems to foretel, in *Hercul. Oet.*

III. *The World is of its own nature Corruptible.*

The splendid Roof of Heaven shall fall,
A certain Ruin doth it attend:
Yea, Glorious gods themselves, and all,
In Chaos and Dark-Night shall end.

But what need have we of the Testimonies of the *Ancient Philosophers*, to assert the Corruption of the *World*; seeing that the present decays of the *VVorld* do manifestly prove its declining, if not decrepit Age? Who doth not perceive, that all things are in a state of Decadence, and hastning on to their last end? Do not we see, that the *Seasons* of the *year* decline, and want much of their former force and vigour? Doth not the *Heat* of *Summer* grow less every year than other? And is not the *VVinter Season* changed from what it used to be? How late, cold, and wet are our *Springs*? And how few seasonable and fruitful *Autumns* do we enjoy? So that all things apparently fall short of their *Primæval virtue*. If we descend into the *Bowels* of the *Earth*, what a small quantity of *Gold* and *Silver* do we meet with there? How few *Veins* of *Metals* are now-a-days discover'd, if we compare them with those multitudes that were found of Old, and in the Times of our Forefathers?

IV. *The general Decadence and Declination of things, portends the approaching End of the World.*

This Failure and Decrease is also observable in other things; for who doth not find, that there are not so many *Men* in the *VVorld* as formerly, and that the *Fields* begin to want *Husbandmen*, the *Camps*, *Souldiers*; and the *Sea*, *Seamen*? And shall not we from this General defection conclude, that *Old Age* hath overtaken the *VVorld*, and that all *Creatures* are hastning to their *Exit*? This therefore is the unalterable *Law* and *Decree* of *GOD*, that all things which have had a *Beginning*, must decrease, grow old, and die at last.

V. *The shortness of the Life of Man is an Argument, that the World grows Old.*

But what needs so many words to prove, that the *VVorld* is grown Old, since we see that *mens Lives* grow shorter every day, being now contained within a narrow compass, as LUCRETIUS expresseth it in his *First Book*:

Man's Age declin'd in Ancient Homer's *days;*
But now his Strength and Stature both decays.

Formerly *Men* lived 800 or 900 *Years*, and upward; whereas now it is look'd upon as a Prodigy, to reach 100 only; and if any by great chance reach so far, then are they encumbred and tormented with so many *Ails* of *Mind* and *Body*, that they long for nothing more than *Death*. And shall we, after all this, suppose that the *Eternity* of this *VVorld* can be consistent with the

the continual crumbling away thereof; the defection of the *Seasons* of the *year*, and the shortning of *mens* lives? Or that that can be perpetual, which is always changing and fleeting?

VI. *The Elements conspire to the destruction of the World.*

Another *Argument* to prove the *Dissolution* of the *World*, may be fetched from those particular changes which antidate the total destruction of the *World*, and divers ways conspire to the Ruin thereof: What vast desolations hath not the *Fire* caused in the *World*? How many *Countries* hath not the *Sun*, whom they call *the Parent of Life, and the Soul of the World*, laid waste and barren? How often hath *Water* been destructive to the *World*? How many *Deluges* have spoiled it, and renduced it to little better than its primæval *Chaos*? And for us that are yet alive, tho' we may hope to live still longer; yet Reason, if we will not stop our *Ears* against her, doth assure us that *Death* follows us at the *Heels*, and will e're long trip us into our *Graves*. And tho' we never saw the Total Ruin of the *World*, or do not perceive any certain passages of its end, yet we have reason to conjecture it not to be far off, since we find it sick of the same *Diseases*, Old Age and other Infirmities, which have led so many of her Off-spring to *death*.

CHAP. IV.

Of the Generation, and Corruption of Things.

I. *How Fire becomes generated out of Wood.*

NOthing is more common with us, than the *Generation* of *Fire* out of *Wood*, by which means a *Fluid* and *Subtil Body* is produced from one that is *Thick* and *Hard*.

This *Generation* of *Fire* out of *Wood*, is not by the Production of any *New form*, as the *Peripateticks* hold, but from the alone disposition of the *parts*; their situation and other modifications which constitute the form of every *Body*. For nothing of the *substance* of the *Wood* is lost, when it burns, and is changed into *Flame* and *Coals*, only the connexion of the *parts* becomes changed, and another mode of *Existence* is acquired: When therefore, at any time, *Wood* is changed by *Fire* into *Fire*, no new Being ariseth, that was not before; but the old *Being* or *Body* is so changed in its *modes*, as that it seems to be a quite different thing. For there is no other change made in *Generation*, save only that which is *Local*, whereby things are so altered, as to appear as other things to our *Senses*.

II. *The generation of a Chicken.*

This change of the Disposition of *Parts* is the cause of the *Generation* of a *Chicken*; for we need not make any difficulty to acknowledge, that the first *Rudiment* of the *Chicken*, grows in the *Egg* after the same manner, as the *Chickens* do that are already *hatched*, *viz.* that all the *Fibres*, whether straight or crooked, whereof their *Organs* do consist, become dilated by the addition of some parts of matter, which joining themselves successively one to another, make the *Pullet* to grow by little and little, and cause the parts of it to appear one after another.

III. *Whether Salt be generated out of Wood, or any other matter.*

Salt is generated out of *Burnt Wood*, as *Chymists* well know, who in their distillations do separate *Mercury*, *Sulphur* and *Salt* from *Bodies*; the parts of which last *Body*, mingle with the *water*, and become incorporated with it.

It is improperly that the *word* of *Generation* is attributed to these kind of Extractions; forasmuch as in them, there happens no adaption of parts, as to *Figure*, *Quantity* and *Motion*; which is necessary to the true Nature of *Generation*, but only a *separation* of *Parts*. For the *Particles* of *Salt* being very small and slender, are easily overwhelmed by the parts of the *wood*, which do never prick the *Tongue*, nor become savoury, except they be separated from the grosser parts thereof by *Fire*. It is manifest, that an *ounce* of *Silver* may be so throughly mingled with a great mass of *Gold*, that there shall be never a part of the *Gold*, which hath not some *Silver* joined with it: Neither will any sound *Philosopher* affirm, that *Silver* is generated, when it is separated from *Gold*, by the means of *Aqua-fortis*; but only that those *particles* which before were mixed with the *Gold*, are now separated from it, and set at liberty. *Salt* therefore, whilst it continues mingled with the *Wood*, retains its own Nature, tho' it cannot be perceived by the *Senses*, nor exert its force; and that because it is covered over with innumerable *particles* of *Wood*, and because the points of it are blunted and broken by its being involved in other *Bodies*.

IV. *How Metals are dissolved by Vapour only.*

Metals are sometimes dissolved by a *vapor* only, as is common amongst the *Chymists* to dissolve *Gold* and other hard *Bodies* by External *Heat*, as in *Hot Water*, by the *Balneum Mariæ*; or by a *Balneum Roris*, that is, the steam only of *Hot Water*.

This is performed, when the steam passing through the *Pores* of the *Vessel*, and entring the *Pores* of the *Gold*, doth dissolve the weaving of its *parts*. For tho' that *Heat* be *slow*, yet because it is of long continuance, it hath the same effect as a drop of *water*, which by its perpetual falling, hollows a *Stone*, and penetrates to the inmost parts of it. Hence it is that *Chymists* having experienced the *virtue* of this continual *heat*, do by means thereof promise us wonderful *Fermentations*, and hope to obtain their *Elixir*, which changeth inferiour *Metals* into *Gold* or *Silver*.

V. *How Liquid Bodies corrupt those that are Hard.*

Liquid Bodies often corrupt *hard Bodies*, so *water* doth corrupt *Sugar* and *Salt*; for a pound of *Sugar*, being cast into a large *Vessel* of *water*, doth disppear in a short time.

Forasmuch as the insensible parts of *Liquors* are in continual agitation, it must not seem strange to us, that the *parts* of the *water*, do so shake the parts of *hard Bodies*, about which they move continually, so as to make them leave their places. Thus we seee that the *Parts* of *Sugar* and *Salt*, do vanish in a short time, and are so scattered and dispersed through all the *parts* of *water*, that there is not one which hath not its share of it.

VI. *Why Glass is not subject to Corruption.*

Some *Bodies* are altogether exempt from *Corruption*, as *Glass*, which cannot be destroyed by the utmost violence of the *Fire*.

The Reason is, because every corruption of *Bodies* proceeds from strange *particles*, intruding themselves into their *Pores*; and by this means altering and destroying, the *Texture*, Connexion and Order of their *Parts*. And therefore those *Bodies* that have more *subtil* and strait *pores*, are for the most

moſt part more durable, and leſs ſubject to *corruption*. And it is for this Reaſon that *Glaſs* is incorruptible; for tho' whilſt it is red hot in the *Fire*, many *particles* do inſinuate themſelves into the *Pores* of it, and do dilate them; yet do they not enter into all the *Pores* thereof; ſo as that the leaſt *particles* of *Air*, or *Water*, which do more cloſely cleave to thoſe of the *Earth*, can wholly be ſeparated from them, and conſequently Exhale.

VII. *Gold and Quickſilver are the moſt Incorruptible of all other Metals.*

And it is for the ſame Reaſon, that *Gold* and *Quickſilver* are the moſt incorruptible of all *Metals*, becauſe they have the moſt narrow pores of any other; as may be demonſtrated by their Ponderoſity. Wherefore alſo their parts cannot without great difficulty be ſeparated from each other, by *the Art of Chymiſtry*; ſo as that the Form of *Gold* and *Quickſilver* be utterly deſtroyed, or that the Gold *be reduced into its firſt Nature*. The ſame alſo may be ſaid of *Talk*, for the reduction of which into a *watry Subſtance* or *Oyl*, many *Chymiſts* have laboured in vain.

VIII. *A Rotten Apple corrupts many that are Sound.*

A *Rotten Apple*, if it be put to a ſound one, doth corrupt it; ſo that frequently it happens, that many ſound ones are ſpoiled by one rotten one.

Which effect proceeds from the *ſteam* which flows from the rotten *Apple*; which penetrating into the ſound one, and agitated by the *ſubtil matter* that is in it, doth diſpoſe the parts thereof in the ſame manner as they are diſpoſed in the *Rotten Apple*. In like manner one Apple laid upon another, promotes Ripeneſs of each other: And therefore thoſe that intend to make *Cyder* of their *Apples*, lay them up in heaps together, to make them ripen the ſooner.

IX. *How Worms are generated in Vinegar.*

Worms commonly breed in *Vinegar*, when it begins to be weakned and putrifie; which are very ſmall and long, and like little *Serpents* ſwim upon it.

Foraſmuch as in every *Corruption*, the Connexion of the Parts is diſſolved, by reaſon of the evaporating of the *Sulphureous Parts*, together with the diſſolved *Saline Particles*, it happens that ſome of them breaking forth from the compound, do unite together in ſome near part, and there conſtitute theſe little *Animals*. After the ſame manner as *Mites* are bred in *Cheeſe*, and like *Inſects* in the *Grain* and *Fruits* of the *Earth*; ſince it cannot well be queſtioned, but that *ſoft Bodies* are ſubject to perpetual inteſtine agitations, by which they are driven into Confuſion.

X. *Animals are produced by other Animals.*

In the mean time it ſeems moſt certain, that all *Animals* are the Products of certain *Seeds*; ſo as not ſo much as a *VVorm* can be produced from the Tumultuary concourſe of *Atoms*, but from a *Seed*, in which is lodged a formative Virtue: And therefore we muſt conclude, that the very leaſt *Animals* are the effect of others; tho', it may be, it is not neceſſary that the *Eggs* whence they proceed, be produced from other *Animals* of the ſame kind. Which ſeems probable as to thoſe *VVorms* which breed in *Galls* and other *Fruits*.

XI. *Spices preſerve Bodies from Putrefaction.*

There is a *Virtue* found in *Spices*, whereby they preſerve *Bodies* from *Putrefaction*: Hence proceeds the cuſtom of *Embalming Dead Bodies* with *Spices*.

The Reaſon is, becauſe *Spices* conſiſt of thoſe *parts*, which can eaſily be agitated by the *ſubtil matter*; ſo that by exciting a new fermentation in *Bodies*, they put the *matter*, which before was at reſt, into *motion* alſo, and put a ſtop to many of their out-flowing *particles*. Thus *Flowers* and *Fruits* are preſerved by means of *Sugar*; foraſmuch as by its clammineſs, it retains their thin and *volatil particles* from flying away; and beſides affords them a pleaſant *Taſte*.

XII. *How Corn comes to be changed into Bread, and afterward into Blood.*

The *Grains* of *VVheat*, being ground in a *Mill* or otherwiſe, is turned into *Flower*, which being mingled with *water* is *kneaded* into *Dough*, and afterwards being *baked* in the *Oven*, becomes *Bread*; which after it hath been chewed in the Mouth, and let down into the *Stomach*, is there by means of an Acid *penetrating moiſture* turned into *Chyle*, and afterwards into Blood.

The Cauſe of which ſeveral Mutations is only to be attributed to *Motion*, by means whereof almoſt all alterations, that happen to *Bodies* are effected, and all that diverſity is produced, which we ſee in *Heaven* and *Earth*. For we are not to imagin, that any new thing is acquired in *the Generation of Things*, nor any thing loſt in their *Corruption*, that was *before* in them, beſides only a new Connexion of *Parts*, and a different *Mode* of *Exiſtence*. So that when the *Grains* of *Corn* are changed into *Flower*, afterwards into *Bread*, and laſtly into *Chyle* and *Blood*; there is nothing in all this progreſs of changes, but *local motion*; tho' the *Species* it ſelf may ſeem to be changed, as *Ovid* appoſitly deſcribes the ſame in the XV. Book of his *Metamorph.*

All alter, nothing finally decays;
Hither and thither ſtill the Spirit ſtrays:
There's nothing permanent, all ebb and flow;
Each Image form'd, doth wander to and fro:
VVhat was before, is not; what was not, is;
All in a moment change from that to this.

But where there is no ſuch change, either of the inſenſible or ſenſible parts, there no alteration can be brought about; as appears in *Gold*, *Quickſilver*, *Talk*, and other *Subjects*, whoſe parts are ſo cloſely joined, as that they cannot by any force be ſeparated; or ſo altered, but that they may return to their former appearance again.

XIII. *How Vapours are ſaid to turn to VVater.*

Nothing is more common with *Philoſophers*, than that *VVater* is changed into *Vapours*, and *Vapours* again condenſed into *VVater*.

I know that the *Peripateticks* do not hold this change to be mutual, ſince they ſuppoſe in every *Generation* a new ſubſtantial *form* is acquired, and that the old one periſheth; and therefore ARISTOTLE expreſſeth himſelf thus, in his *2d Book of Generation, the laſt Chapter: VVhen Air is turned into VVater, and VVater into Air, that Air will be the ſame Kind, but not the ſame in Number.* But this doth not ſeem probable at all, ſeeing that in theſe changes there may be reſtitution of the very ſame parts. For as an *Engine* or *Machin*, that conſiſts of 100 or 200 parts, when it is taken to pieces, can by a Skilful *Artiſt* be put together again ſuch as it was before: So in like manner may *water* return again to its former ſubſiſtence and appearance, by the coming together again of the *particles*, which had been diſſolved into *vapour*? Who will ſay that a *drop* of *water*, which riſeth up in a *vapour* to the head of the *Alembick*, and there is turned into *water* again,

again, is not numerically the ſame; ſeeing that all its parts may be again united, and take up the ſame *Figure* and *place* they had before. All the difference therefore that there is betwixt *water* and *vapour*, depends only on the *motion* and *figure* of its parts, becauſe the *parts* of *vapour* are more agitated, and are at a greater diſtance from each other, than the parts of *water*, whoſe motion is leſs, and which takes up a leſſer ſpace.

XIV. *The change of Bodies depends on the Tranſpoſition of their Parts.*

Thus we ſee that *VVood*, by a multifarious tranſpoſition of its *parts* is changed into *Flame* and *Soot*, and laſtly into *Aſhes*. Thus *Vegetables*, when they are putrified, turn into *duſt*, or a ſlimy ſubſtance. Neither can we imagin any other way whereby *Mites* are bread in *Cheeſes*, but that *Flies* or other *Inſects* do lay their *Eggs* in them, which afterwards become dilated, and undergo various changes as to their *figure*, ſituation, *&c.*

CHAP. V.

Of the Heaven, or moſt ſubtil Æther.

I. *Why the Heaven is a moſt looſe Body.*

THAT the *Heaven* is a moſt looſe or rarefied *Body*, and conſiſts of many moſt *ſubtil parts*, may be demonſtrated from the *Light* of the *Sun* and the *fixt Stars*, which through the ſame is tranſmitted with unconceivable ſwiftneſs to an incredible *diſtance*. To which may be added the perpetual *action* of theſe *Stars*, and the excitation of *Heat* in theſe inferiour parts, by means whereof, tho' theſe *particles* had not been moſt ſubtil before, yet muſt they have neceſſarily become ſuch, eſpecially thoſe which are higher, and nearer to the *Lucid Bodies*, as being more particularly the ſubjects of their Activity.

II. *What we are to underſtand by the word Heaven.*

For by the word *Heaven*, we are to underſtand nothing elſe but that immenſe *Extenſion* of the *matter* of the Firſt and Second *Element*, which reacheth from the *Star* that is placed in the *center* of a *Vortex*, to the *circumference* of it. Thus the *Vortex* wherein we are, contains all that ſpace in which the 7 *Planets* are whirl'd round; the middle part whereof is moſt ſwiftly ſnatched about, and all the other parts ſtill ſlower, as they are at a farther diſtance from the *Center*.

III. *What is the Cauſe of the Changes that are obſerved in the Planet* Venus.

It is evident that the *Heavenly* Bodies are no leſs changeable, than thoſe that are upon the *Earth*, and that they alter their *Figures* and *Colours*; as appears from thoſe *Phaſes* or *Changes* that are obſerved in the *Planet Venus*, which differ but little from thoſe of the *Moon*, and are much alike repreſented to the *Eye*.

The Cauſe of theſe *Changes* is the motion of that *Planet*, which ſwiming in the *fluid Heaven*, makes its circumvolution about the *Sun*, and produceth new *changes*, according as it is carried above, below or ſideways of the *Sun*. For ſeeing that the *Planets* ſhine with a borrowed *Light* they receive from the *Sun*; they likewiſe repreſent ſeveral Faces to us, ſuitable to their poſition, with reſpect to the *Sun*, as whether in *Conjunction* with it, *Oppoſition* to it, or any other Aſpect.

IV. *Whence it is that the Planet* Venus *appears ſometimes greater, and at other times leſs.*

It is notorious, that *Venus* doth at ſome times appear 40 times bigger than at other times; and that when ſhe is biggeſt, ſhe appears *Creſcent-wiſe*, and *Round* when ſhe is leaſt. Which proves that *Venus*, when ſhe appears round, is in her higheſt ſtation; and in her loweſt, when ſhe is ſeen like a *Creſcent*. Which appearances do ſufficiently evince, that *Venus*, as well as *Mercury* do not run round the *Earth*, but are whirld about the *Sun*; and conſequently that our *Earth* is placed between *Venus* and *Mars*.

V. *The Come's paſs from one Heaven into another.*

The *Comets* run through ſeveral *Regions* of *Heaven*, and are moved ſo ſwiftly, that within a few days they quite vaniſh from our *Eyes*. For they are found to paſs through vaſt ſpaces beyond the *Sun*, and to run from one *Heaven* into another.

This *Motion* of the *Comets* is a ſtrong and convincing proof of the *fluidity* of the *Heavens*, which we have demonſtrated in our *Inſtitution of Philoſophy*, without which there could be no paſſage of Bodies through them. For how could the *Stars* or *Comets* move from one place to another, if they were ſurrounded with a *Solid Body*? The *Comets* therefore are ſwiftly moved through the *Heavenly Spaces*, becauſe the *Heaven* is like our *Air*, tho' much more pure, which with the greateſt eaſe yields to *Solid Bodies*, and makes way for them. But of the *Comets* more hereafter.

VI. *The Bodies in Heaven, that are once moved, do always continue their Courſe*

The Bodies that are moved in the *Heaven*, do paſs every way without ſtop, and move with ſuch a force, that they run through all ſpaces with an equal ſwiftneſs; the contrary to which we find in our *Air*; where the *Birds* cannot fly without wearying themſelves, becauſe of the oppoſition it makes to their *motion*.

GASSENDUS, to avoid this difficulty, ſuppoſed empty ſpaces in the *Heavens*, to which he attributes the ſwift motion of the *Stars*, as ſuppoſing them void of all *Matter*, excepting only the *Beams* of the *Sun* and *Stars* which paſs through them. He alſo ſuppoſeth that the *Stars*, how bulky ſoever they may be, have no ponderoſity, and conſequently that they do not ſtand in need of any *Medium* to ſupport them; as *Birds* ſtand in need of the *Air*, and *Fiſhes* of the *Water* to bear them up. But foraſmuch as we have already confuted this Opinion of *Gaſſendus*, and proved that there can be no *Vacuity* in the *World*; I ſhall only add one word, that in caſe a *Vacuum* be once admitted, there can no longer be any diſtance between thoſe Bodies that are moſt remote from one another: Which is the ſame, as if one ſhould ſay, that there is *extended ſpace* in the *World* without *extenſion*; and that there is that which is *high* and *deep*, without *Heighth* and *Depth*. The Reaſon therefore why ſome *Stars* do freely wander through the *Heavens*, and meet with no ſtop in their Courſe in the *Heavens*, is not becauſe the *Fluid Body*, through which they are carried, doth not hinder their *motion*; ſince it is a contradiction, that there ſhould be any ſuch *Body* in Nature; but becauſe the parts of this *Liquid Subſtance*, which are variouſly moved, without tending one way more than another, are determined by the *ſubtil matter*; and complying with the *motion* thereof, are carried towards a certain Region of the *Heavens*. Not much unlike that which we obſerve in the other *Scale* of a Ballance; which with the leaſt impulſe from without, is either raiſed or depreſt.

VII. *Why the Heaven doth not hinder the motion of Bodies.*

For as the *Particles* of the *Heavenly Matter* are most *subtil*, so are they most apt to admit motion, or any determination of it: Partly because most of them are of a *Spherical Figure*; and partly because the *Motion*, and the *Resistance*, which *Bodies* meet with in their *motion*, are proportionable to their Bulk: And therefore a weaker cause, and which is not endued with the greatest force, may easily suffice, either to push forwards these most *subtil particles*, or to determine their motion.

VIII. *Why the Heaven, when it is clear, appears of a Blue Colour.*

The *Heaven*, when it is free from *Clouds*, appears of a *Blue Colour*; which *Colour* also is seen at the *rising of the Sun*, if before *Day-break* it was full spangled with *Stars*: For then, as well in the *place* where they *shine*, as where they become extinct by the *Light* of the *Sun*, every way this *Blue Colour* doth appear.

This *Adventitious Colour*, is not so much to be attributed to the *Heavenly* Body it self, as to the *Vapours* and *Exhalations* which hang over us. For it is certain, that the *Heaven* sends forth no *Light*, and that indeed it would appear very dark to us, if there were not other intervening *Bodies*, which did reflect some *Beams* to us, or which sent back to our *Eyes* those *Globuli* of the 2*d Element*, which the *Sun* or *Stars* have dasht against them. For since these *Vapours* are very *loose*, and are very much dilated, the *Heavenly Globuli* do not meet with *particles* enough, so as to be with equal swiftness moved round their own *Centers*, as in a *straight Line*; and this is the Reason why the *Heaven* appears of a *Blue Colour*, as before hath been said. And it is for the same reason also, that the *water* of the *Sea*, where it is most clear and deep, shews of a *Blueish*, or *Sea-green Colour*.

IX. *Why the Heaven cannot be really of a Blue Colour*

But that the *Heaven* is not indeed ting'd with a *Blue Colour*, is evident from hence, because if it were so, all the *Stars* which we see through it, would appear to us of the same *colour*, as those things which are beheld through a colour'd *Glass*, seem to us of the same *Colour* as the *Glass* is.

X. *How it comes to pass that some new Stars do arise in the Heavens.*

Many *Stars* do appear in the *Heavens*, which were never seen there before; according to what *Astronomers* tell us of the *Star Merosus* or *Electra*; which having appeared in the *Heaven* a long time before the *Trojan War*, did afterwards vanish by degrees. TYCHO BRAHE also hath observed another, which shone for many years together in the *Heaven*, and afterwards disappeared.

The Cause of these and other *New Stars*, is by *Astronomers* attributed to the Corruptibility of the *Heavens*. For whatsoever is generated in another, doth borrow the matter whereof it consists from the same, and takes its Rise from the Dissolution thereof. There being no greater *Argument* of the Corruptibility of any thing, than that many things are generated and corrupted in it. But now more particularly, these *New Stars* do arise, or appear, when at any time the most *subtil matter*, collected in the *Center* of its *Vortex*, having dispersed its *Spots*, doth press the *Globuli* of the 2*d Element*, as before: Or when the matter of the first *Element*, flowing in great abundance from a neighbouring *vortex* to the obscured *Star*, doth diffuse it self over the *Spots* that cover'd it, whereupon it shines forth again.

CHAP. VI.

Of the Sun.

I. *Why the Sun appears to move from East to West.*

THE *Sun* is observed daily to describe a *Circle Parallel* to the *Æquator*, from *East* to *West*.

In order to the explication of which appearance, we are to suppose some things set down in our *Institution of Philosophy*.

1*st*. That the *Heavenly Matter* which surrounds the *Sun*, doth whirl continually round about it.

2*dly*. That the *Vortex* of the *Sun* carries the *Elementary Matter* along with it.

3*dly*. That the *Circle* which the *Elementary Matter* doth describe, is Excentrical.

4*thly*. That the *Axis* of the said *Circle* is always *Parallel* to it self.

5*thly*. That the said *Axis* inclines on the Plain of the *Excentrick Circle*, which the *Earth* describes.

6*thly*. That the *Elementary Mass* doth turn round about its *Center*, at the same time that it whirls about the *Sun*. These things thus supposed,

It is manifest that the *Sun*, and whatever else appears in the *Heaven*, must appear to us, as daily describing a *Circle Parallel* to the *Æquator*. For seeing that the *Earth* is turned about the *Sun*, the *Sun* also must appear to take the same course, and to describe a *Circle*; which would be the same with the *Æquator*, in case the *Axis* of the *Earth* were *Parallel* to the *Plain* of the *Excentrical Circle*, which it describes about the *Sun*, but which necessarily differs from it, and which it intersects, by withdrawing from it 23 degrees and an half; because the *Axis* of the *Earth* is just so much inclined upon the *Plain* of its *Excentrical Center*. The *Earth* therefore roling about its own *Center*, from *West* to *East*, within the space of 24 *hours*, the *Sun*, and whatsoever else we suppose to be immoveable in the *World*, must needs appear as if it were carried by a contrary motion from *East* to *West*.

II. *Why the Sun appears greater in some Signs than in others.*

The *Sun* appears *greater* to us, when in the *Southern* part of *Heaven*, than in the *Northern*.

Because then the *Earth* is in its *Perigæum*, or in that part of its *Excentrical Center* which is neareſt to the *Earth*: And besides, the *Sun* must of necessity appear more days under the *Southern Signs*, than under the *Northern*; because the *Æquator* cuts the *Excentrick* of the *Earth* into 2 unequal parts; and that the *Earth* describes the greater half from the *Day* wherein the *Sun* doth appear to us under the *beginning* of the *Ram*, till the day that he enters the *Balance*; which is the reason that it makes more diurnal Revolutions in this half, than in the other.

III. *How the Sun is said to be hot.*

The chiefest and most common effect of the *Sun*, is *Heat*; which it every way transmits to us. For whereſoever the *Sun-beams* come, they bring *Heat* along with them, and cause those effects, which we see the *Flame* daily produceth. And therefore PARMENIDES and HERACLITUS, as *Stobæus* tells us, did believe the *Heaven* to be *Fire*, and that the *Stars* were so many flaming *Torches* placed in it; by which the *Light* is conveyed to us, and from whence, as so many *Fountains*, the vigour and life of all things here below do proceed.

They

To the Right Honourable Edward Earle of Darwentwater, Lord Radclyffe, Son and Heyre of the Right Honourable Francis Earle of Darwentwater, Viscount Radclyffe & Langley, and Baron of Tindale &c.

This Plate is humbly Dedicated, by Richard Blome.

They who follow ARISTOTLE, attribute this effect to the *virtue* of the *Sun*, and not to its *ſubſtance*, which they will not allow to be endued with a *Fiery Nature*, and that it is only *virtually hot*; but not to the *Touch*. Like *Ginger*, or *Spirit of Wine*, which excite a *heat* in the *Mouth* and *Stomach*; tho' it cannot be felt with the *Hand*. But how doth it appear to theſe *Philoſophers*, that the *Sun* is only *Eminently hot*, and not *Actually*? Were they ever ſo near it, as to touch it with their *Hand*? Had not they much better attribute a Natural and Real *heat* to it, ſince they find it in all things to be like *Fire*? There is nothing here on *Earth* that is more moveable than *Flame*, which by its great Activity and Mobility, diſſolves all *Bodies*. Have not the *Aſtronomers* obſerv'd as much, who, with the aſſiſtance of an *Helioſcope*, have ſeen the *Sun* in appearance of *Gold boyling* in a *Furnace*; or like a *Sea of Fire*, with its *waves* rouling through and over one another? And what elſe is *Formal Heat*, but *the various Motion of the Parts of a Body*, whilſt they are diverſly agitated and carried againſt one another? Now that this happens in the *Sun* no Man will deny, but he who is ignorant of the Nature of it. And as to the Inſtance they alledge of *Ginger* and *Spirit of Wine*, that makes more for us, than for them; ſeeing that they are not perceived to be *hot*, till the *ſubtil Matter* hath excited a *motion* in their *parts*, and ſeparated them from each other. But the *Particles* of the *Sun* are in perpetual *motion*; and tho' they do not make any Excurſions beyond the Bounds wherein they are contained; yet do they vary their *ſituation*, and are carried divers ways.

IV. *Why the Sun, at his Riſing and Setting, doth commonly appear Red.*

The *Sun* commonly appears *Red* at his *riſing* or *ſetting*.

Becauſe the *Light* at that time paſſeth through abundance of *Nitrous Vapours*, which make it ſubject to *Refractions*, much like thoſe which a *Priſm* is the cauſe of; and we ſhall be eaſily perſuaded to be of this Opinion, if we will take the pains to obſerve, that when we diſtil *Saltpeter*, in order to the making of *Aqua-fortis*, the *Vapours* which ariſe and circulate in the *Recipient*, do make a *Candle*, held on the other ſide of the *Recipient*, and viewed through thoſe Steams, to appear very *Red*. And by the ſame Reaſon it is, that the *Sun* appears *red* to us, when we look upon it through a *Glaſs*, upon which we have put ſome *Ink* or *Soot*.

V. *Why the Sun is of a Spherical figure.*

The *Sun* appears *round* to the Eye, eſpecially if it be aſſiſted with a good *Teleſcope*, whoſe *Concave-glaſs* is tinged with ſome *pale Colour*, eſpecially a *Violet*; for then it doth not appear Round like a *Diſh*, but *Spherical*.

The Reaſon of this is, becauſe the Matter of the *firſt Element*, which conſtitutes the *Body* of the *Sun*, doth endeavour every way to withdraw from its *Center*, and by an equal preſſure puſheth forward the ſurrounding *matter*. For it is a *Law of Nature*, that *Bodies* which are circularly moved, withdraw, as much as they can, from the *Center* of the *Circle* they deſcribe, and conſequently leave thoſe *Round ſpaces*, which are afterwards filled with the *Subtil matter* of the *firſt Element*. And foraſmuch alſo as the *Vortex*, wherein the *Sun* is formed, is on every ſide preſſed by the encompaſſing *Vortexes*, and ſo is hindred from proſecuting its *motion* in a *ſtrait line*; therefore it muſt of neceſſity continue *Round*, and never attain any other *figure*. As appears in a *Glaſs*, which is formed of a *Round figure*, whilſt the *Air* that is blown into it through a *Pipe*, doth equally preſs the parts of the *Glaſs* one way as much as another.

VI. *Why the Sun ſometimes appears of an Elliptical figure.*

The *Sun* ſeems ſometimes to be of an *Elliptical figure*, *viz.* about his *ſetting*.

The Reaſon whereof is to be fetch'd from the Refraction of its *Rays*: For the *Sun-beams* are refracted in a thick *Vapour* about the *Horizon*, at a greater diſtance to the Right and Left hand, than upwards and downwards, as thoſe that have skill in *Dioptricks* demonſtrate, which it will be ſufficient to have only mention'd here. For who doth not know that a *Circle* is changed into an *Elliptical* or *Oval figure*, by *Reflexion*, as in a *Cylindrical Glaſs*, and by *Projection* upon a Plain obliquely oppos'd; and alſo by *Refraction*.

VII. *The Sun always appears of the ſame bigneſs and figure.*

The *Aſtronomers* never obſerved any change in the *Sun*, but own it to conſiſt of the ſame *Bulk*, and to enjoy the ſame force and virtue, as it had from the beginning. Which ſome alledge, as an Argument to prove, that it cannot be of a *fiery Nature*, becauſe *Fire* always ſtands in need of *Fewel* to maintain it, upon the withdrawing whereof it becomes extinguiſh'd.

Tho' the *Sun* be conſider'd as a *flame*, and ſeems obnoxious to the ſame defects, as a *Flame* is; yet cannot we conclude from thence, that it ſtands in need of *fewel*, as our *fire* doth. For, according to the *Laws* of *Nature*, *Every Body always continues in the ſame ſtate*, till it be forced by a foreign *Body*. Whence it is evident, that *Fire*, being of a *fluid* and *moveable Nature*, is eaſily deſtroy'd and choaked by the Matter that doth ſurround it, and that conſequently it ſtands in need of continual *Fewel* to ſupport it, that as faſt as any of its Matter vaniſheth, other may be reſtored in the ſtead of it. But the caſe is not the ſame with the *Sun*, whoſe Ruin is not conſpired by the *parts* of *Heaven* that are about it. But yet it doth ſtand in need of ſome *aliment* or *fewel*, which is no other than the ſame Matter of the *firſt Element*, which as it runs out by the *Ecliptick*, or thoſe places which are moſt remote from the *Poles* of the *Sun*; ſo new Matter enters again to the *Sun*, by the *Poles*, and recruits the defect of that which is gone away. Wherefore as a *River* is ſaid ever to continue the ſame, as long as it is recruited by the continual ſucceſſion of new Parts of *water*: So likewiſe the *Sun*, by this entrance of *New matter*, doth continue the ſame, and keeps the ſame *bulk* and *figure*.

VIII. *Why the Sun is felt more hot in the Torrid Zone, than elſewhere.*

Tho' the *Sun* cauſeth different *Seaſons* over the whole *World*, and by his preſence produceth *Heat* every where: Yet we find the contrary in the *Torrid Zone*, where there is nothing elſe, but continual extream *Heat*, even when the *Sun* is moſt remote from it; whereas it grows weaker, when the *Sun* is perpendicular to it: So that they who live between the *Æquinoctial* and the *Tropicks*, do begin their *Summer* about *Chriſtmaſs*, and their *Winter* about the Feaſt of St. *John Baptiſt*.

This

This difference of *Seasons* proceeds from the *Sun* it self, which hovering directly over the *Heads* of the *Inhabitants* of the *Torrid Zone*, doth raise up many *Vapours* to that height, that by their meeting with the *cold Air*, they are immediately turned into *water*, and consequently cause almost continual *Rains*, which do very much cool and refresh the *Air*: But when the *Sun* is no longer perpendicular to them, the *Rain* ceaseth, and the *Air* being deprived of its coolness, grows so hot, as scarcely is tolerable.

IX. *Why the Sun doth blacken some Men, and not the Fire.*

In some Parts of the *World* Men are colour'd *black*, as those who live in *Guinea* and *Æthiopia*: Which effect the *Fire* doth not produce, tho' it exert a greater force upon *Bodies*, than the *Sun*. And hence it is that those who make *Glass*, are rather of a *pale*, than a *black Colour*.

The Reason whereof is, because *Fire* exerts its Force most upon the *Blood* and the *Spirits*, causing them to exhale; which makes *Men* that labour much in the *Fire* to be of a *pale* and somewhat *tawny Complexion*: Whereas the more benign *heat* of the *Sun* only draws the *Blood* towards the outward parts of the *Body*, and does rather concoct it there, than cause it to evaporate. And therefore it is that the *Ethiopians* are indeed of a *Fleshy habit* of *Body*, but not so well and handsomly made, and generally have thick *Hips*, which shews that their moisture is shut up rather, than exhausted.

X. *Whence the Twilight, and the differences thereof do proceed.*

In the *Morning* before the *Sun* riseth, and in the Evening after its *setting*, we have the *Twilights*, which in some parts of the *Earth* are perpetual, and exclude the *Nights Dominion*.

The Cause of these *Twilights* is, when the *Sun-beams* falling obliquely upon the *surface* of the *Air* and *Atmosphere*, become refracted towards the *Earth*, and entring the same, are reflected back again by the *particles* of *Air* and *Vapour* they meet with. These *Twilights* begin and end, when the *Sun* is 18 *Degrees* distant from the *Horizon*; for if it sink lower, it makes *Night*. Whence it is evident, that in those *Countries* where the *Sun* in Summer time doth not sink 18 *Degrees* below the *Horizon*, there they enjoy a continual *Twilight*, and have no perfect Night.

XI. *Why the Sun appears sometimes, to be in the place where it is not.*

This Refraction of the *Sun-beams*, is the cause that the *Stars*, which are near to the *Horizon*, do seem to make a stop there, and to set, as it were, with some delay or reluctancy; and accordingly towards Evening, reach the *Lines* that point out the *Hours* on *Sun-Dials* more slowly, and so make the *Hours* longer. As also that sometimes the *Sun* appears together with the *Moon*, at the time of its *Eclipse*, tho' it be necessary for the producing of an *Eclipse*, that the *Moon* be interpos'd between the *Earth* and the *Sun*. And that the *Hollanders* in *Nova Zembla*, after a continual *Night* of 3 *Months*, see the *Sun* above their *Horizon*, and at the very *Meridian*, 15 *Days* sooner than according to the position of the *Sphere* they ought to find him there. The Reason whereof is, because the *Ray* which is betwixt the *Eye* and that Point of the *Atmosphere*, wherein the *Refraction* is performed, is not terminated in the *Sun*, but somewhat above it: Which is the true cause, why the *Sun* appears higher than indeed it is. Thus the *Virgins Ear of Corn*, a very refulgent *Star*, appears to us to rise, when it is yet 32 *Minutes* under our *Horizon*; which we conclude from hence, because it seems to rise when the *Lions Tail* is 34 *Degrees* and 30 *Minutes* high, and in the same quarter in which that *Star* of the *Lion* then is. But the *Lions Tail*, and the *Spike of the Virgin*, are distant from each other 35 *Degrees* and 2 *Minutes*.

XII. *Why the Eclipse of the Sun always begins at the West side, and that of the Moon on the East.*

The *Eclipse* of the *Sun* always begins from the West, but that of the *Moon* from the East.

The Reason is, because the *Moon*, by her *motion* towards the *Earth*, doth with her Eastern part enter upon the Western part of the *Earths shadow*, as well as of the *Sun*. And therefore it is that she, in her *Eastern part*, begins to be *Eclipsed* by the *Western part* of the *Shadow*: and the *Sun* on the contrary, on its Western part, because of the *Eastern shadow* of the *Moon*. And forasmuch as that which last suffers the *Eclipse*, doth last recover its Light, it always happens that the *Eclipse of the Moon* ends towards the West, and that of the *Sun* to the East.

XIII. *Why the Heat of the Sun is most vehement after the Summer Solstice.*

It is observed, that the *Heat* is not so great at the *Solstice*, when the *Sun* darts his *Rays* more perpendicularly down upon us; as some days after, when the *Sun* begins to decline from our *Hemisphere*:

The Reason is, because the *Sun*, in its approach to our *Horizon*, doth every day heat the *Air* with more direct and perpendicular *Rays*, and makes a longer stay above our *Horizon*, until the time of the *Solstice*. And since these direct *Rays*, together with this longer stay of the *Sun*, doth sensibly continue for some days; and that continually like degrees of *Heat* are still added to the *Heat* that is already acquired, it cannot be otherwise, but that the *Heat* by this means must be much increased. So that the *Heat* cannot decrease till the *Sun-beams* do very sensibly deflect from their former Directness, and till the stay of the *Sun* above our *Horizon*, be considerably shorter.

XIV. *Why the Sun at his Rising and Setting, appears greater, than in the Meridian.*

The *Sun*, when it is nearest to the *Horizon*, appears greater, than when it is farther from it, towards the *Meridian*; because there it is conceived to be highest.

The Reason of this Deception must be fetch'd from the *Refraction of the Rays* (according to the Opinion of almost all *Philosophers*) in the *Dewy Vapour*, which inflexion of the *Rays* doth dilate the visive *Angle*, and thereby increase the *Bulk* of the *Object*. For seeing that the *Vapour* is but lifted up a little way above the *Horizon*, on the Plain whereof, notwithstanding it is far and wide extended, it so happens that more of the *Solar Beams* do meet on this and that side, than upwards, and consequently make the longer *Diameter* of the *Sun*, which is then seen to be *parallel* to the Plain of the *Equator*. But the *Sun*, when it is about the *Meridian* and *Vertical* to us, doth appear higher, because the *Rays* which proceed from the *Sun*, passing through *Bodies* of different Rarity or looseness of the Parts, *viz.* the *Æther* and the *Air*, are refracted towards a Perpendicular, and therefore reach the *Eye* through a great *Refraction*. And thus it comes to pass, that the *Eye* apprehends the *Sun* to be much higher than indeed it is: For the *Eye*, or rather the *Mind* of *Man*,

Man, doth measure the Greatness of the *Object* according to the *Right Line*, which last of all reacheth his *Retina*, or Net-like-Coat of his *Eye*. it happens also that the *Ray* which is understood to be continued from the Point of the *Atmosphere*, whence the *Refraction* is made to the *Eye*, is not terminated at the *Sun*, but doth reach somewhat above him; where the *Mind* takes occasion to apprehend him higher than indeed he is.

It may also be said, that the *Sun* being near the *Horizon*, the *Eye* doth wink less, because of those *Vapours* which dull the *Sun-beams*, and therefore suffer the *Apple* of the *Eye* to be more dilated, than when the *Sun* being up on high, near the *Meridian*, there are few or no *Vapours* interposed between him and our *Sight*; by which means, when the *Apple* of our *Eye* is fixt upon him, it becomes the more contracted. Now it is evident, that the *Image* introduced through the more dilated *Apple of the Eye*, doth produce a larger appearance of the *Object*, than when it enters through a *contracted Apple of the Eye*. Because probably in the former case it doth strike more of those little *Nerves*, whereof the *Organ* consists. Thus we find that the *Moon* appears less in the *Day*, than at *Night*: For in the Day-time the Hole of the *Uvea* is more narrow, and therefore the *Rays* that enter through it being nearer to the *Axis*, are not so much dispersed.

XV. *The Sun, about the time of its Rising and Setting, seems to tremble*

The *Sun*, at his *Rising* and *Setting*, seems to *tremble*, to whirl about its own *Axis*, and to leap, as it were, according to that of CLAUDIAN, in his *1st Book of the Praises of Stilico*:

Then did Bright Titan's *Horses lead a dance*
To th' following Stars.

And hence it is, that that Story arose amongst the Common People, of the *Sun*'s *Dancing* on *Easter-day* in the *Morning*; as believing, that all Created things do testifie their Joy on that Day, because of our *Saviours Resurrection*, and that the *Sun* in particular testifies the same by his *Dancing* at that time.

XIV. *Why the Sun at his Rising and Setting, appears greater, than in the Meridian.*

Some there are, that attribute this effect to the *Sun*'s *turning round*, as if in so doing the Brim or Edges of it were really shaken, and so with a kind of *Palpitation* whirl'd round about his *Axis*: But this is found to be false, because the motion of the *Sun* about its own *Center* is insensible; which Rotation therefore cannot be perceived, but after many repeated Observations. This seeming *Trembling* therefore is caused, by those *Vapours* that interpose between the *Sun* and our *Eye*, which being agitated by its *heat*, do represent a kind of *Trembling motion*; and therefore the *Beams* that pass through them, do shake the *Retina* in such a manner, that the *Sun* appears to the *Eye* to leap and skip. In the very same manner as the *Sun* is seen to tremble on a *Paper*, or against a *Wall*, when the *Smoak* of a *Candle* doth intercept its *Rays*; or like as a *Stone*, that rests at the *bottom* of the *River*, seems to tremble, because of the Stream or Current of *Water* that runs over it.

XVI. *Why Redness in the Sky, at the Sun rising, is a sign of Rain; and at his Setting, of Fair-weather.*

If the *Heaven* appears *Red* at *Sun-rising*, it doth presage *Wind* or *Rain*; whereas at *Sun-set*, the same *Redness* doth promise *Fair-weather*. *Redness*, appearing in the *Morning*, fore-bodes *Wind* or *Rain*; because this is a Sign, that seeing there are but a few *Clouds* in the East, the *Sun* may elevate many *Vapours* before Noon, and that those *Mists* which will produce the same, are already Rising. Whereas on the contrary, this *Redness* appearing in the Evening, portends *Fair-weather*; because this shews, that there are none, or very few *Clouds* gather'd in the *West*; and consequently, that *Eastern-winds* have the predominance, and that the *Mists* will be driven downwards during the *Night-season*.

CHAP. VII.

Of the Fixed Stars.

I. *How the Stars are moved from West to East.*

THE *Fixed Stars*, besides their *motion* from East to West in 24 *Hours*, have another from West to East, within *Circles Parallel* to the *Ecliptick*; according to which *Circle* they move only 2 *Degrees* in the space of 200 *Years*, and finish the whole *Round* in 36000 *Years*.

The *Diurnal*, or *Daily Motion* of the *Stars*, is evidently deduc'd from the Circumrotation of the *Earth* upon its own *Axis*; and as to the other *Motion*, which they call *Periodical*, it will be sufficient to say, that the *Earth*, when it wheels every *year* about the *Sun*, doth not so exactly observe its *Parallelism*; but that it doth, as it were, reel a little from it, by which means it comes to pass, that its *Poles* do answer to different parts of the *Firmament*, and that consequently its *Poles*, during the space of many *Thousand years*, describes a *Circle* from East to West. This being suppos'd, forasmuch as we conceive the *Æquator of the Earth* to correspond to different parts of the *Heavens*, it follows, that the *Æquator of the Earth* is changed after the same manner, and divides the *Ecliptical* at various Points, whose sequel is from East to West. And because the *Longitude* of the *Fixt Stars*, is taken from the common Section of the *Æquator* and the *Ecliptick*, it is necessary that the *Stars*, how fixt and immoveable soever they be, must every *Hundred years* appear, to have moved somewhat from the *West* to the *East*.

II. *The motion of the Fixt Stars, is irregular.*

Wherefore it is no wonder, if the *motion* of the *Stars* be irregular, and that the *Astronomers*, who followed HIPPARCHUS, discover'd, that their *motion* from *West* to *East* was so much increased, that the *Longitude* of every *Star* was augmented to 28 *Degrees*, beyond what it was observed to be at the time of our *Saviour*. Because probably this *Reeling motion* of the *Earth*, may have been more manifest in one *Age*, than in another.

III. *The Fixt Stars shine with a Light of their own.*

The *Fixt Stars* do *twinkle*, and dart their *Beams* from them, as the Sun doth, who shines with a *Light* of his own.

The Reason whereof is, because the *Fixt Stars* are as so many *Suns* in their proper *Vortexes*, consisting of a most *fluid Matter*, which with the greatest swiftness is whirled about its own *Center*: Whence it is that they always press that *Matter*, which is continuously extended from the *Stars* to our *Eyes*, and thereby produce the Sense of *Light*. For if the Sun were placed amongst the *Fixt Stars*, he would not appear greater to us, than the very least

leaſt of them: And on the other hand, if the *Little Dog-Star*, by Example, which is accounted the leaſt of all the *Fixt Stars*, ſhould be in the place of the *Sun*, there is no queſtion to be made, but that he would be equal to the *Sun*, both in *Bigneſs* and *Light*. From whence we may gather, that the *Sun* hath not ſtrength or force enough to lend his *Light* to the *Stars*, and that therefore we muſt conclude, that they muſt ſhine with their own proper *Light*, without borrowing it from any other *Body*: Tho' PLINY and METRODORUS were ſo much taken with the admiration of the *Sun*, that they thought him ſufficient to illuſtrate the whole *World*.

IV. *Why the fixt Stars are conſpicuous to us, and not the Comets, when they are out of our Heaven.*

Hence it is, that the *Light* of the *Fixt Stars* reacheth our *Eyes*, and not that of *Comets*, except only when they are within our *Heaven*; becauſe the *fixt Stars* having a *Light* of their own, do dart the ſame much more ſtrongly, than the *Comets* can, who only reflect the *Light* to us, which they have borrowed from the *Sun*. And therefore cannot be ſeen by us, when they are too remote from our *Heaven*: For it is well known, that the greater the diſtance of any *Body* is, ſo much the leſs is the *Angle* under which it is ſeen by us.

V. *Why Stars are ſeen by us in thoſe places where they are not.*

There are many *Stars* which are not ſeen by us in their *Right places*; yea, ſometimes it happens, that one and the ſame *Star* appears in different places.

This proceeds from the *Vortexes* of thoſe *Stars* that ſurround our *Heaven*: For their *ſurfaces* having ſeveral *Corners*, cannot be ſo aptly joyned, but that the *Beams* which proceed from them, muſt ſuffer divers *Refractions*. Whence it is, that when they are viewed from the *Earth*, they do not appear in thoſe places, where indeed they are; but as if they were in thoſe places of the *ſurface* of our *Vortex*, through which thoſe *Beams* paſs, which come from them to the *Earth*. And ſeeing that thoſe Places, ſince the time that they were firſt obſerved by *Aſtronomers*, are not found to have been changed, therefore the *fixt Stars* are ſaid to keep the ſame ſituation or diſtance from each other, and to continue in the ſame ſtation. Which gave occaſion to MACROBIUS to ſay; *Behold the 7 Stars, which never ſcatter themſelves from each other, no more than their Neighbours the* Hyades, *nor quit the ſtation they have near to the Conſtellation of* Orion. *Neither do the Great and Leſs* Bear *deſert their places; nor the* Serpent, *that glides between them, ever change the Ring wherewith he winds himſelf round about them.*

VI. *Why the Stars are only ſeen by Night.*

The *fixt Stars* are not perceived by us, ſave in the *Night*; and in the *Day* time are inconſpicuous to us.

The *Light* of the *fixt Stars* cannot be ſeen in the *Day time*, becauſe the *Rays* of the *Sun* are of greater force, than the *Rays* of the *fixt Stars*, ſo as to diſable them from affecting our *Eyes*. And therefore it is that by how much the nearer the *Eye* is to the *Sun*, the leſs can it perceive the *Light* of the *fixt Stars*: Becauſe their Force becomes altogether weakned by the far more vigorous *heat* of the *Sun*; according to that *Rule* which always takes place in the meeting of *Bodies*, *viz.* That *thoſe things, whoſe Force exceeds that of others, they obtain their effect*. Tho' ſometimes it may ſo happen, that *Stars* may in the Day time be ſeen by us, as, according to what *Hiſtorians* tell us, it hapned under the *Empire* of COMMODUS, when the *Stars* appeared for a whole Day, *as if they had been fixed in the Air*. The cauſe whereof I ſuppoſe to have been, becauſe the *Sun*, at that time, being cover'd with Darkneſs, did give forth weak or almoſt no *Rays* at all, which being not ſufficient to reſiſt the *Action* of the *Light* of the *fixt Stars*, they conſequently appear'd viſibly to *men*. As we ſee that Perſons let down into a *dark* and *deep Pit*, or *Well*, can thence ſee the *Stars* in the Day time.

VII. *The fixt Stars always appear in the ſame ſituation.*

The *fixt Stars* do always appear the ſame to us, and never increaſe or diminiſh their Bigneſs. Whence it is, that the *Stars* which paſs over our *Vertical Point* in the *Crab*, are ſeen the ſame in *Capricorn*.

The Reaſon is, becauſe the *Axis*, about which the *Earth* whirls round every Day, doth always continue unchanged. Whence it is, that that Point which is *Vertical* to us, when the *Earth* is in the *Crab*, is as far from that which is over our *Heads*, when it is in *Capricorn*, as the one *Tropick* is from the other in the *Great Orb*. But foraſmuch as all this diſtance, and the whole *Great Orb*, is but as a Point with regard to the *Heavens*, therefore alſo the *Interval*, that comes between the 2 *Vertical Points*, is alſo to be eſteemed no other than a Point.

VIII. *How New Stars come to appear in the Heavens.*

New Stars do now and then ariſe in the *Heavens*, which ſome time after do vaniſh again: As that which appeared in the *Swan*, in 1600, much about the Bigneſs of one of the *third Magnitude*; and that other which appeared in *Serpentarius*, in 1604, which was almoſt of the ſame bigneſs with *Venus*; whereof the one continued for many years; but the other diſappeared, after having continued its ſtation for one *Year* only.

The Cauſe of the *Riſe* of *New Stars* is, as was ſaid before, the diſſolution of *Spots*, wherewith ſometimes the *Body* of a *Star* becomes ſo cover'd, that by their thickneſs, or hardneſs, they hinder it from ſhedding any of its *Rays*. When therefore it ſo happens that a *Star* becomes freed from thoſe *ſpots*, by one means or other, then immediately a *New Star* appears to our *Eyes*, which it may be had not been ſeen for ſome hundred years before. Now the diſſolution of thoſe *ſpots* happens, when the *Vortex* that encompaſſeth the *ſpots*, doth with greater force preſs upon its Neighbouring *Vortexes*, than they puſh upon it: For then the ſaid *Vortex* enlarging its own Borders, cauſeth the Matter of the *firſt Element*, which flows forth from the *Eclipticks* of other *Vortexes*, to run in greater abundance towards the obſcure *Star*, where ſpreading it ſelf over the *ſpot* that covers it, and making an impreſſion on the *Heavenly Globuli*, it doth by this means conveigh the Action of the *Light* to our *Eyes*.

IX. *How comes it to paſs that Stars vaniſh from our ſight.*

And on the other hand we find, that ſometimes *Stars* which have appeared many years, afterwards diſappear. Thus formerly the *Aſtronomers* counted 7 *Pleiades*, whereas now 6 only of them are to be ſeen.

The

To the Right
Worshipfull Company
of Drapers of
London, This Globe
and Theame is
Humbly Dedicated
by their Most
Obedient Servant
Will. Sanderson

To the Right Honourable
Elizabeth Countess Dowager of
Winchelsea, Vis-countess Maidston,
and Baroness of East-well &c.

This Plate is humbly Dedicated by Ric: Blome.

ADVERSIS MAIOR PAR SECUNDIS

The Reason whereof is, because the *spots* about these *Stars* grow so thick and close, that they can no longer be dissipated or dispelled by the said *Star*, nor the *Heavenly Globuli* be push'd forwards. Because nothing doth more conduce to the preservation of a *Vortex*, and keeping it from being destroyed, than when the *Star* that is in the *Center* of it, is in a vigorous condition to push forwards the *Globuli* of the 2*d Element*, and by that means hinders the neighbouring *Vortexes* from encroaching upon his Territories, and hurrying away of his *Globuli*. Thus the *Star* in *Cassiopeia* appeared in 1572, and the other in the *Breast* of the *Swan*; which being first discovered by KEPLER in 1602, vanished in 1626; and after this was seen again by the Famous HEVELIUS in 1656, of the same magnitude as it had before been observed by *Kepler*. About the beginning of the year 1660, it appeared less than formerly; and in 1661, it disappeared again till the year 1666. Thus at the beginning of this *Century*, there was a *Star* observed in the Neck of the *Whale*, which presently after becoming extinct, appeared again in the year 1648, till the Learned BULLIALDUS, had calculated the motion of it. For after a *Circle* of 333 days it appeared again. The same Reason must be given of that *misty Star*, which at sometimes is conspicuous in the *Girdle* of *Andromeda*.

X. *Why Stars do sometimes appear in the day-time.*

Stars are seen in the *Day-time*, either when the *Sun* suffers a *total Eclipse*, or when the *Spectator* beholds them from the bottom of a deep *Well*.

For seeing that in these cases there is no *reflexion* of the *Sun-beams*, and that the *Spectator* is placed in nocturnal darkness; the *Apple* of the *Eye* being by this means dilated, and the *Optick Nerve* free from the dazling splendor of the *Sun*, or at least being not compress't by it, the smallest *Beams* of the *Stars* are capable of affecting it, so as to make the *Stars* become sensible.

XI. *The Fixt Stars are sometimes changed into Comets, or Planets.*

The *Stars* are sometimes changed into *Comets* and *Planets*, and losing their own Light, only reflect that which they borrow from others.

The Reason of this is deduced from what was said before. For when a *Star* is altogether covered with *Spots*, and hath lost all its force of pushing forwards the matter of the 2*d Element*, it may easily be so prest upon by the neighbouring *Vortexes*, as to be swallowed up by one of his strong and vigorous *Neighbours*. And when the *Vortex* of the *Star* is thus swallowed, and the *Star* being wholly covered with *Spots*, and carried into another *Vortex*, it then either passeth farther, and is driven again from that *Vortex*, which first swallowed it, into another *Vortex*, and so becomes a *Comet*; or because of its being less solid, doth descend lower, keeping a certain distance from the *Star* which possesseth the *Center* of that *Voxtex*, and thus becomes a *Planet*; and continually wheeling about the said *Star*, doth reflect its *Light*; and thus the *Body* which was *Lucid* and *Fluid* before, by the access of these *Spots* becomes hard and solid.

CHAP. VIII.

Of the Moon.

I. *Why the Moon hath always the same side turned towards the Earth.*

THE *Moon* hath always one and the same Face turned toward the *Earth*; neither could ever any *Telescope* inform us, that its *Body* hath changed its former *situation*.

The Reason is, because that part of the *Moon* which is furthest from the *Earth* is more *solid*, that is, contains more of the matter of the 3*d Element*, and hath fewer *pores* that are filled with the *matter* of the 1*st* and 2*d Element*. For it is apparent, that *solid Bodies* do withdraw themselves further from the *Center* of the *Vortex*, in which they are, than those which are less close, and abound with more *Pores*. Because they have a greater force to continue their *motion*, and to abide in the state wherein they were put at first. As it is evident in *Gold*, *Lead*, and other *metals*, which do longer retain the impulse impress't upon them, than *Wood* or *Stones* of the same *bulk* and *Figure*. The Reason therefore why the same *Face* of the *Moon* is always turned towards us is, because *that* part of her which reflects *Light* from the *Earth*, is less solid, and doth contain less *matter* of the 3*d Element*, and therefore requires a less space to move in. Now that that part of the *Moon* which faceth the *Earth*, is less solid than the other part, may be gathered from those *Spots* and *Shades* which appear up and down in it; and which by letting in, and swallowing up the *Sun-beams*, produce darkness, and make an *Opake Body*.

II. *An Objection Answered.*

But there are some *Philosophers* that pretend, that the *Moon* is whirld about her own *Axis*, all the while that she is turning round about the *Earth*, within the time of about 29 *days* and an half; because, say they, the *Sun* in a *months* time, enlightens all the parts of the *Moon* one after another. But it is an easie matter to make it appear, that the *Moon* will be *enlightned* in a months time in all its parts, tho' we should suppose it not to move at all about its own *Axis*, but only to be moved about the *Earth*.

For Example, let T be the *Body* of the *Earth*, S the *Sun*, B C D E the *Circle*, which the *Moon* describes about the *Earth* in 29 days and an half; and let the *Moon* be so placed in this *Circle*, as to be in *Conjunction* with the *Sun* at the point B, opposite to the point D, in her first quarter at the point C, and in the last quarter at the point E. This supposed, it is evident, that the *Moon* being at B, shall have her upper half 1, 2, 3, enlightned; and that being in her opposition to the *Sun* at D, her lower half 3, 4, 1, will be so. That when she is at her first quarter at C, the half of her 2, 3, 4, will be illuminated: And lastly, that when the *Moon* is in her last quarter at E, the half of her marked 4, 1, 2, will receive the *Rays* of the *Sun*. Which makes it evident, that the *Moon*, in order to her being illuminated in all her parts, hath no need to turn round about her own *Center*, seeing that her running through the *Circle* wherewith she encompasseth the *Earth*, is alone sufficient for that purpose. Figure 14.

III. *The Moon from all parts reflects Beams to the Earth.*

The *Moon* diffuseth her *light* every way, and doth so reflect the same, as that the *Rays* do not unite in one point only, but are dispersedly reflected, and scattered every way.

This

This proceeds from the *Rugged Surface* of the *Sun*, which dilates the *Light* it receives, and shews its *Brightness* to all that behold it. For *Rough Bodies* do consist of many *Surfaces*; which are so disposed, as that some of them reflect their *Beams* this way, and others that way. But if the *Moon*, whom all *Philosophers* grant to be *Spherical*, were smooth and like a *Convex Looking-Glass*, not in all its parts thus *polisht*, but in one part only; it would convey its Light to the *Spectators Eye* in one *point* only, as hath been before demonstrated. For certain it is, that an *Opake Globe*, having a polish'd *surface*, doth not reflect its *Light*, but as it were, from one point, as is manifest in *Brass Globes*, exactly polish'd, when they are exposed to the *Sun*. For tho' the whole *Hemisphere* were exposed to the *Light* of the *Sun*, yet would only the least part of the *Moon*, transmit the *Light* thereof to the *Eye* of a *Spectator*; which because of the smallness of it, and its vast distance from that *Star*, must needs be extinguish'd, before it could arrive to his *Eyes*.

IV. *While the Sun shines, the compass of the Moon seems less than in the night-time.*

When the *Sun* shines, the *Moon* appears less than in the *Night*: which GASSENDUS assures us he had experienced by the help of a *Telescope*; and found the Compass of the *Moon*, at full in the Night-times, to be 5 *minutes* bigger than her true *Diameter*. Which may also be confirmed by a more familiar Experiment, *viz.* by beholding the *Moon* when it begins first to appear at eventide, whilst the *Sun* is yet above the *Horizon*: for then its *Crescent* will appear so very slender, that it appears but like a *Thred*; whereas when the *Sun* is wholly gone down, it grows broader and broader, as the darkness encreaseth.

This encrease of the *Light* must not be ascribed to the *Body* of the *Moon*, as if it had Power of sending forth *Beams* from it self, and of dilating them in the *Night-time*; but only because the *Æther*, or that *Matter* which is analogous to our *Air*, and encompasseth the *Moon*, is enlightned by the *Sun-beams*, which she reflects, and seems the same as the *Body* of the *Moon*: For being most intimately joined to the same, it is supposed to belong to the same *Circle*. But by making use of a *Telescope*, this false *Light* is easily discerned, for then that space, which is supposed to be illuminated, doth appear dark, and not at all touch'd by the *Arc* of the enlightned part.

V. *Why the Moon is not seen, whilst she is in Conjunction with the Sun.*

The *Moon*, when in Conjunction with the *Sun*, doth not shed any *Light*, neither can she be seen till she be 2 degrees distant from the *Sun*. And afterwards changeth her *Faces*, according to her different *aspects* to the *Sun*.

This diversity of appearances is caused, for that the *Moon* doth borrow her *Light* from the *Sun*, and shines no otherwise than a *Looking-Glass* doth, which sends back the *Beams* that *light* upon it. Wherefore it is no wonder, if at the *Conjunction*, nothing of the illuminated part of the *Moon* be discerned by us, because then her whole enlightned half faceth the *Sun*, the other part being turned towards us. But during the following days, whilst she turns sideways, and hath a *Sextile Aspect* to the *Sun*, some part of her is perceived in the form of a thin *Sickle* or *Crescent*: But in the 7*th* or 8*th* day in her *Quadrant Aspect*, when she is one *Quarter* of the *Zodiack* distant from the *Sun*, the one half of her appears in sight. But whilst she is in the 3*d* part of the *Zodiack* distant from the *Sun*, above one half of her *Rim* doth appear; and on the 14*th* or 15*th* day, when the *Moon* is directly opposite to the *Sun*, her whole Face is turned to us.

VI. *Whence the perpetual variety of the Motion of the Moon doth proceed.*

The *Moons motion* changeth every *day*, *hour* and *moment*: for she moves most swiftly at the Full and New; and thence her *swiftness* decreaseth from the Full to the First Quarter, where she moves more slowly, and then her *Motion* encreaseth again till the New.

The Reason of this perpetual *variety* is, because the concave or hollow *surface* of her *Sphere* is not round but *oval*: So that the *Vortex* of the *Earth* must of necessity move with unequal degrees of swiftness in its circumference: For every *Fluid Body*, passing through a *narrower* space, doth accelerate its *motion*, as we see in a *River*, when it runs through the *Arches* of a *Bridge*, whereby it becomes straitned in its Current, and therefore is hastned in its *motion*, by the following *water* pressing upon it. Forasmuch therefore as an oval *Figure* hath one *Diameter* longer, and the other shorter, the *Fluid Æther* passing through the latter, where it is more straitned for *Room*, doth of necessity move more swiftly, than when it passeth through the longer *Diameter*, where it hath more Room; and because in every part of an *Oval Figure*, there is a different wideness or capacity, there must needs follow a variety in the swiftness of motion through those spaces of different wideness; and accordingly there must be a longer *Oval Diameter* betwixt the *Quarters*, and a shorter between the *Full* and *New Moon*, or thereabouts.

VII. *Why the distance of the Moon, from the Earth, is sometimes more, and at other times less.*

From what hath been said, we may easily be satisfied about the Reason of the variety of the *Distance*, *Bulk* and *Brightness* of the *Moon*; because when the *Moon* is in her *Quarters*, near the longer *Oval Diameters*, she is at a greater distance from the *Earth*, than in the *New* or *Full Moon*, when she is near, or at her shorter *Diameters*; and forasmuch as the *magnitude* and the *light* do grow or decrease equally with the distance, therefore the *Swiftness*, *Distance*, *Bulk* or *Splendor* must appear greater or less, not only about the four extream oval *Points*, but at all the other points of the Planetary Circle, according as the Capacity or Room betwixt the oval sides of the said *Circle* is greater or less.

VIII. *Whence the Secundary Light of the Moon doth proceed.*

The *Moon*, whilst she is in an *Eclipse*, doth present an obscure light to our Eyes.

It seems probable, that this *Secondary* Light proceeds from the *Sun-beams*, reflected from the *Earth*: If we speak of that *Light* which is seen in the New or Old *Moon*; but that *Light* which appears in her, whilst she is *Eclipsed*, must be attributed to the Refraction of the said Beams, from the *Air* that surrounds the *Earth*. For seeing that the *Sun* doth continually dart his *Beams* against the *Earth*, they cannot be so admitted by it, but that they must rebound again from the *Earth* towards the *Sun*; and because the *Sun*, when *New* and *Old*, is in that *Region*, she must needs receive the more *Beams*, as she is nearer to the *Sun*. And accordingly it is necessary that the *Moon* be enlightned with the said reflected *Light*, especially in that part of her, which is not directly *illuminated* by the *Sun*; altogether in a like manner, as the *Earth* is enlightned by a light reflected from the

Body

Body of the *Moon*, in that part of her which is turned from the *Sun*. Now that this *Secondary Light* doth proceed also from the *Refraction* of the *Air* that surrounds the *Earth*, doth appear from hence, because the *Globe* of the *Earth* encompassed with its *Atmosphere*, doth project a *Conical Shadow*, whose length consists of about 250 *Semidiameters* of the *Earth*. And because the *Sun-beams*, *horizontally* falling upon the *Atmosphere*, are according to TYCHO's observation refracted at an *Angle* of 34 *minutes*; and that they double this *Angle* in their passage from it, therefore consequently they are united in the *Axis* of the *Shadow*, and there are decussated or cross one another, and so pass away, and produce the *Cone* of a *Shadow*, whose top, or extremity is not above 43 *Semidiameters* of the *Earth* high, on this side the *Decussation*, or before they come to cross each other; and beyond their Decussation an inverted *Cone*, which afterwards is confounded with the residue of the greater *Cone*.

IX. *Why the Moon is moved more swiftly than the Earth.*

The *Moon* ☽ which moves round in a peculiar *Vortex* A B C D, that compasseth the *Earth* T, is whirl'd as swiftly again about the *Earth*, as the *Earth* whirls round its own Axis. For the *Moon* runs round her own *Circle* A B C D, which 60 times exceeds the Circumference of the *Earth* T, in the time that the *Earth* only 30 times runs round its own *Axis*, by its *Diurnal Motion*.

Figure 29. in the Institutions.

Tho' some boast themselves to have cleared this *Phænomenon*, yet there seems no other reason assignable of it, but only the littleness of the *Moon*. For seeing that the *Earth*, as well as the *Moon* it self, is moved by the same *Celestial Matter*, no other cause can be imagined of this greater degree of *swiftness* in the *Moon*, than that she is less than the *Earth*. For this is the *Rule* of all moving *Bodies*, that whilst one is moved as swiftly again as another that is twice as big, there will be but just as much *motion* found in the less *Body* as in the greater. Now forasmuch as the swiftness of the *motion* of the *Body* of the *Moon* ☽, and of the *Earth* T, is from the *Celestial Matter*, which is much the same about the *Earth* as about the *Moon*; the *Earth* ought to whirl about as swift again, as it doth, in order to the running over its *Cirtle* 60 times in the same time that the *Moon* once runs through hers, A B C D, 60 times greater, but that its Bulk doth hinder it.

X. *Why the Moon appears greater at her Rising and Setting, than when she is elevated above the Horizon.*

When the *Moon* Riseth or Sets, she appears to us much greater, than when she is high raised above our *Horizon*.

The Reason is, because when she is very high above our *Horizon*, there are no *objects* that interpose between her and our *Eyes*, whose *magnitude* is known by us; that by comparing her with them, we might be able to judge of her *Bulk*: But when she is newly got above our *Horizon*, or is near *Setting*, we see betwixt her and our selves many *Fields*, the largeness whereof is in some part known to us, by which we know her to be farther from us, and consequently judge her to be greater.

XI. *The Moon moves swifter at the New and Full, than in other parts of her Circle*

The *Moon* doth not observe an equal tenor in running through her *Circle*: For when she is in *Conjunction* with, or in *Opposition* to the *Sun*, that is, at *New* and *Full*, she is more swiftly moved than in any other of her *Aspects*.

The Cause of this Inequality of her *Motion*, is her particular *Heaven* A B C D, the Circumference whereof is not absolutely *Spherical*, but is somewhat *Elliptical*. For when the *Globuli* of the 2*d Element*, which are comprehended within the Circumference A B C D, differ in *motion* and *magnitude* as well as *solidity*; it must needs follow, that the more solid ones must more freely diffuse themselves towards A and C, than towards B and D, and so constitute an *Oval* or *Elliptical Figure*. And therefore it is that the *Heavenly Matter* is more slowly moved betwixt C and A, which is the larger part of that particular *Heaven*, than that which is betwixt B and D, which is the more narrow part. For it is consonant to Reason, that the Matter which carries the *Planet*, should flow more slowly in a broader space, and more swiftly in a narrower. As is evident in *Rivers*, whose *Course* is so much the swifter as their *Channel* becomes more narrow, and more slow where it widens.

XII. *Why the Moon is beheld under a greater Diameter at her Conjunction and Opposition.*

This *Oval Figure* of the *Moons Circle* also, is the Cause why the *Moon* at her *Conjunction* and *Opposition* is less distant from the *Earth*, than at her *Quarters*; and consequently is seen under a greater *Diameter* at the time of her *New* and *Full*.

XIII. *How it comes to pass, that the Moon doth not fall down to the Earth.*

There is one difficulty still remaining, which is this: If the *Moon*, because of its littleness, be capable of a swifter *motion*; how is it, that when she is carried about by the *Heavenly matter* that surrounds her, she doth not sink down towards the *Earth*; and why, leaving her *Circular motion* when she is at C, she does not decline towards Z, rather than go to D, and then turn upwards again.

We shall extricate our selves from this Difficulty, by considering that the *Moon* doth altogether follow the *motion* of the *Celestial matter*, tho' it have not all the degrees of swiftness which the said *matter* hath. For seeing that the *Earth*, and all the *Celestial matter* contained in the *Vortex* A B C D, is turned round about the *Center* T; it follows, that the *Moon* which is whirl'd about the *Celestial matter*, must continue its *motion* towards the *Center* of the *Earth* T; and that after it hath reached the point C, it dos not proceed towards Z, but goes towards D; and that because the *Heavenly matter* drives it that way, and carries it along with it.

XIV. *Whether the Colours of the Moon be any certain Signs of the Weather.*

It is a common received opinion, that the *Moon*, as she appears under several *Colours*, presages *changes* of *Weather*: Which gave occasion to these Verses.

The Pale Fac'd Moon, gives Rain;
When Red, 'twill blow amain:
But when she's Fair and Clear,
Like Weather will appear.

But we must not imagine that this variety of *Colour* is in the *Body of the Moon*; but in that exhalation or steam which is between the *Eye* and it. Hence it is, that when *Rainy Clouds* are interpos'd between our *sight* and the *Moon*, she appears of a *Pale* and *Dusky Colour*; and again *Red*, when she is surrounded with many windy *exhalations*, and a moderate quantity of *Vapour*. It being a thing notorious that *Colours* are changed, according to the diversity of the *medium* through which they are transmitted. And accordingly when the *Air* is free from all manner of *Exhalations*, then the *Moon* appears *fair* and *Clear*.

XV. *Why Eclipses of the Moon do appear alike, to those that live in the same hemisphere, but not those of the Sun.*

An *Eclipse* of the *Moon* appears alike in Quantity, to all those who live in the same *Hemisphere* of the *Earth*, and have the *Moon* above their *Horizon*. Whereas a *Solar Eclipse* appears to some Inhabitants of the same *Hemisphere*, *Partial*; to others, *Total*; and to some again none at all.

The Reason hereof is evident from what hath been delivered in my *Institutions of Philosophy*. For seeing that the *Moon* is destitute of any *Light* of her own, she must of necessity appear as much to some, as she is perceived of others deprived of *Light*. Whereas the *Sun* having an inborn *Light* of his own, and being only hidden by the *Body* of the *Moon*, which is interposed between the *Sun* and the *Earth*, and is less than either of them; it may so happen, that some part of the *Earth* appearing equal to the *Sun*, or bigger, may hide the whole *Sun*; another the half of him; another a greater or less part; and another again no part at all. Thus that *Eclipse* which THALES is recorded to have observed about the *Hellespont*, was Total; whereas at *Alexandria* in *Egypt*, it was only of 9 digits, with 3 fifths: Or as CLEOMEDES reports it, of 4 fifths of a *Diameter*.

CHAP. IX.

Of the Planets, Mercury, Venus, Jupiter, *and* Saturn.

I. *The Planets*, Mercury *and* Venus, *seem to move variously.*

MErcury and *Venus* appear sometimes to move from *East* to *West*; and at othertimes the contrary way, from *West* to *East*.

Forasmuch as the *Earth* is turn'd round about its *Center* from *West* to *East*, within the space of 24 *hours*, it follows that the *Planets*, *Mercury* and *Venus* must seem to move from *East* to *West*, and every day to describe a *Circle Parallel* to the *Æquator*. In like manner they must also trace a *Circle* about the *Sun* from *West* to *East*; forasmuch as they are comprehended in the *Heavenly matter*, which carries the *Earth* that way.

II. *Why the foresaid Planets are more swiftly carried about the Sun, than the Earth.*

These 2 *Planets* are also more swiftly rolled about the *Sun*, than the *Earth*, which doth not finish its Circumvolution in less than a *Year*.

The Reason is, because the *Circles* which *Mercury* and *Venus* run through, about the *Sun*, are lesser than that in which the *Earth* is carried; and therefore it is necessary, that the true Circumvolutions of these 2 *Planets* be absolved in less than a *years* time.

III. *Why* Mercury *and* Venus *seem to move more slowly, than indeed they do.*

These 2 *Planets* seem to take up more time in their *Circumvolution*, than indeed they do.

The Reason is, because if we fix the beginning of one of their *Revolutions*, when these *Planets* are placed betwixt the *Sun* and the *Moon*, this *Period* cannot be said to be finished, till they be come back to the same place again. Now forasmuch as the *Earth* it self hath changed its place, whilst those *Planets* run through their *Circles*, and at the end of their circumvolution is no more at the same place where it was at the beginning of it; it follows that the appearing *Period* of every *Planet*, must of necessity comprehend, not only the whole *Circumvolution* it hath absolved; but besides all that space to which the *Earth* hath past through during the time of the *Planets Circumvolution*.

IV. Cassinus *his Observations about the Planet* Mercury.

CASSINUS observes concerning the *Planet Mercury*, that the same is scarcely visible, because of his great nearness to the *Sun*, so as that it but very seldom gets free of his *Rays*. For he is not above 27 or 28 *degrees* distant from the *Sun*, and often turns back to the *Sun* again, by that time he is got 18 *degrees* from him, so that his greatest elongations, from the *Sun*, do not differ above 9 *degrees* from each other.

The *Circle* of *Mercuries Motion* divides the *Ecliptick*; and with it makes an *Angle* of 6 degrees; so as that the *line* of *Section*, is not far from the *Center* of the *Sun*. The *Northern Intersection*, which some call the *Node*, is reduced to the 13*th degree* of *Scorpio*: and these *Nodes* proceed one *degree* within the space of 40 *years*.

Forasmuch therefore as *Mercury* doth not appear to us, but in his withdrawing from the *Sun*, he can scarcely be perceived with the help of a *Telescope*, in the form of a *Globe* or *Round Body*, but sometimes as if he were cut in 2, as the *Moon* appears at her *Quarters*; and sometimes more swell'd, and at others more depress. And when at any time he is near the *Horizon*, or darkned with *vapours*, then nothing but his *Bulk* or *Figure* can be detected. However it is apparent that he receives his *Light* from the *Sun*, and is carried round him.

V. Cassinus *his Observations about the Planet* Venus.

Concerning the *Planet Venus*, the foresaid *Cassinus* hath observed; first that this *Planet* is sometimes 40 *degrees* and an half distant from the *Sun*, that is, as far as the *Moon* at 4 days old is distant from him. Tho' sometimes it happens that she returns to the *Sun*, after a recess from him to 45 *degrees*; so as that the furthest elongations of this *Planet* do not differ above 2 *degrees*.

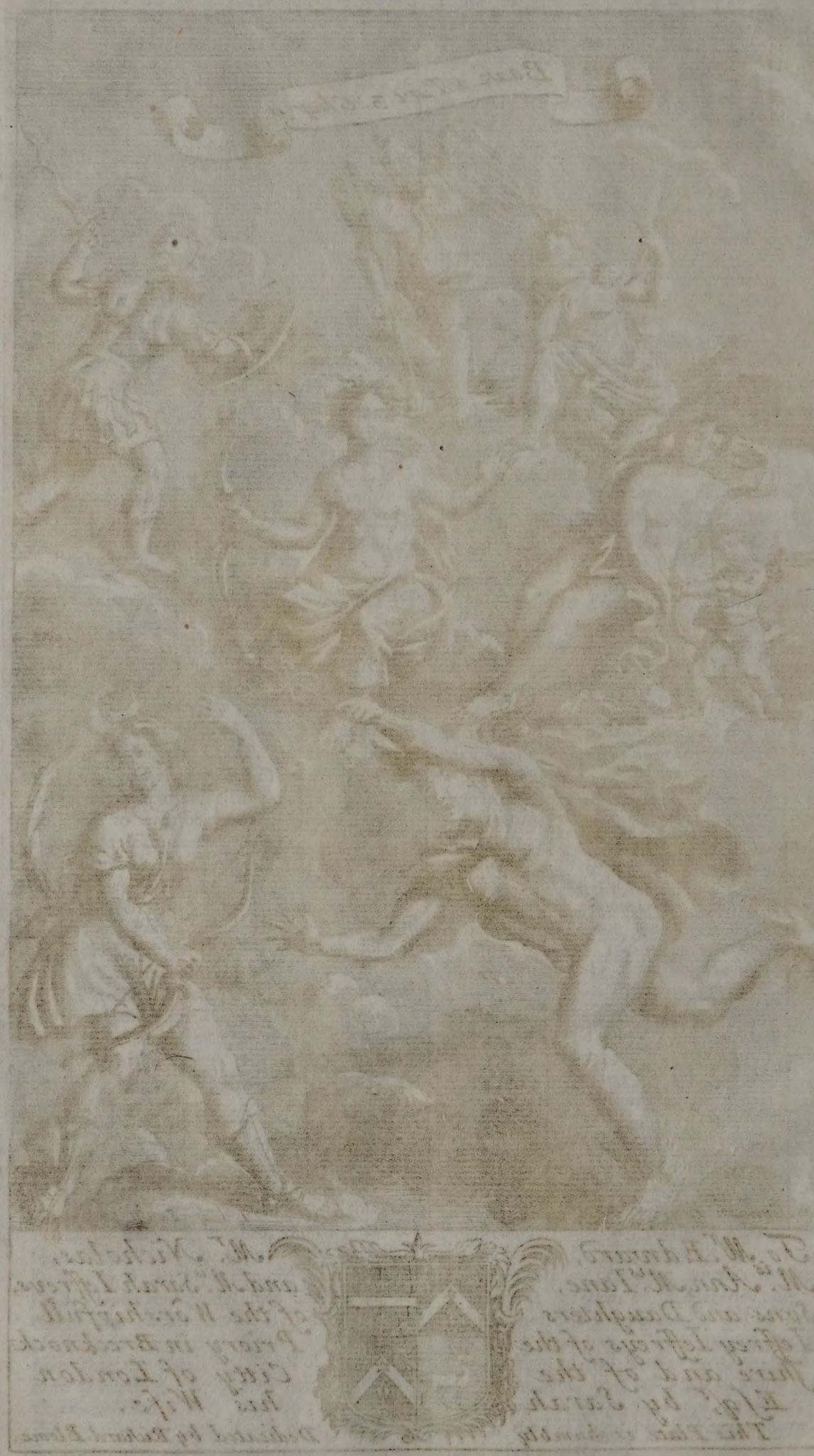
The *Aphelium*, or farthest distance of *Venus* from the *Sun*, is in the 2*d* degree of *Aquarius*; her *Perihelium*, or neerest approximation in the 2*d* of *Taurus*: and these *Points* do continually move onwards towards the *East*, so as that within the space of 46 *years*, they proceed one degree.

The foresaid famous *man* found that these 2 *Planets* moved about their own *Centers*. For when in the *year* 1666, he had observed one part of *Venus* to be brighter than all the other parts of her *Circumference*, on the 14*th* of *October*, 5 *hours* and 15 *minutes* after *Noon*; and the year following on the 24*th* day of *April*, about a quarter of an hour before Sun-set, had found the same *bright part*, near to the *Line* which separates the *Lucid part* of *Venus* from the *Opake*, and distant from her *Southern* Horn, above a quarter of the *Diameter* of *Venus*: and when after *Sun-rising* he had observed that the said *Bright Part* was further removed from the *Southern Horn*, from which it was distant the 3*d* part of her *Diameter*; he immediately concluded, that some kind of *motion*, at least, must be assigned to the *Globe* of *Venus*, tho' he dares not determine whether the same be a *motion* of *Rotation*, or of *Libration* only: Because *Venus* doth not present her self to her view but for a short time. But supposing that bright part, which he had so often seen, to have been always the same, he is not afraid to affirm that the said *motion* is finisht in about 23 *hours*; after which the said bright part of *Venus* returns again to the same place.

Mars,

To M.r Edward, and M.r Nicholas,
M.rs Ann, M.rs Iane, and M.rs Sarah Ieffreys,
Sons and Daughters of the Worshipfull
Ieffrey Ieffreys of the Priory in Brecknock=
shire and of the Citty of London
Esq.r by Sarah his Wife.

This Plate is humbly Dedicated by Richard Blome.



VI. *Why* Mars, Jupiter, *and* Saturn *do unequally observe their Course.*

Mars, *Jupiter*, and *Saturn*, ſeem to roll about like other *Planets*, within the ſpace of 24 *Hours*, from Eaſt to Weſt about the *Earth*; but not equally within the ſame term of Time.

The Reaſon is, becauſe the *Circles* they deſcribe do include the *Circle* of the *Earth*, and becauſe they, as well as the *Earth*, do ſwim in the *Celeſtial matter*; and conſequently muſt appear, as the other *Planets*, to turn from *Eaſt* to *Weſt*, within the ſpace of 24 *Hours*. And foraſmuch as, according to the Law of *Mechanicks*, the *Circles* which *Mars*, *Jupiter*, and *Saturn* do deſcribe, muſt be found under the *Zodiack*, and are greater than that which the *Earth* moves in, we ſhall eaſily apprehend, that they cannot finiſh their *Circuit* in ſo ſhort a time as it doth. Accordingly we know, that *Mars* takes up 2 *years* in performing his *Circumvolution*, *Jupiter* 12, and *Saturn* 30; for they being at a farther diſtance from the *Sun*, than the *Earth*, the *Heavenly matter* which carries them about, muſt take up the ſame time in abſolving of its Courſe.

VII. Caſſinus, *his Obſervations concerning* Mars.

CASSINUS alſo gathers from thoſe *ſpots*, that obſcure the *Aſpect* of *Mars*, that this *Planet* moves about his own *Center*, in the ſpace of 24 *Hours* and 40 *Minutes*, becauſe theſe *ſpots* return to the ſame place, at the ſame diſtance of time. He obſerved in *Mars* one part more bright than all the reſt, and always in the ſame ſituation; tho' the other *ſpots* had their different places.

Jupiter, when he is in Conjunction with the *Sun*, appears at a greater diſtance to us, than when he is in oppoſition to him; inſomuch that we ſee him almoſt bigger by one half, when he is oppos'd to the *Sun*, than when conjoyn'd with him. And *Mars* appears five-fold greater, when he is neareſt to the *Earth*, than when he is at his furtheſt Elongation from it.

VIII. *The ſecondary Planets about* Jupiter, *firſt diſcover'd by* Galilæus.

GALILÆUS, in the year 1610, the 7*th* of *January*, at the firſt Hour of the Night, diſcovered 4 leſs *Planets* about *Jupiter*, which like ſo many little *Moons* are whirl'd round him. Thoſe of them which are neareſt to *Jupiter*, move more ſwiftly, than thoſe which are more remote. The Revolutions of which *ſecondary Planets* are thus calculated by SIMON MARIUS:

The firſt and inmoſt of them takes up,				The Second.			
D.	H.	M.	S.	D.	H.	M.	S.
1	18	28	30	03	13	18	0
The Third				The Fourth.			
D.	H.	M.	S.	D.	H.	M.	S.
7	03	56	34	16	18	09	15

Theſe Attendants of *Jupiter*, whenever they enter the Verge of his *ſhadow*, do ſuffer an *Eclipſe* after the ſame manner, as the *Moon* doth when ſhe dips in the *ſhadow* of the *Earth*, and are totally depriv'd of *Light*; as being *Opake Bodies*, which borrow their *Light* from the *Sun*. The 3 firſt of theſe in every *Revolution*, produce 4 *Eclipſes*; the 1*ſt*, when the *Satelles* enters into the *Rim* of *Jupiter*; the 2*d*, when the ſhadow of the *Satelles* doth darken the *Rim* of the ſaid *Planet*; the 3*d*, when the upper part of *Jupiter*, at his *Elongation* from us, doth hide the *Satelles*; and the 4*th*, when the *Satelles* dips in the ſhadow of *Jupiter*: So as that the *firſt Satelles*, within the ſpace of 7 *Days*, doth effect 16 *Eclipſes*; the *ſecond*, 8; the *third*, 4; ſo as that all of them together produce 28 *Eclipſes*: The *fourth*, after that he hath reached the *Nodes*, doth make 4 *Eclipſes* in 17 *days*; but when near his bounds, he never ſuffers a defect of his *Light*, becauſe his *Latitude* is ſo large, that he never touches the *Rim* of *Jupiter*, or reacheth his *ſhadow*. Theſe *Eclipſes* are of great uſe, in order to the determining of the *Longitudes* of *Places*.

IX. *The* Satellites *of* Saturn, *diſcover'd by* Caſſinus *and* Hugenius.

Saturn hath alſo been found guarded by 3 *Satellites*: The *firſt* of theſe was diſcovered by CASSINUS, at *Paris*, in the *Royal Obſervatory*, in the Year 1672; and the ſame is remov'd from the *Center* of *Saturn*, 1 Diameter of the *Ring*, (mention'd by the *Author*, *Chap.* 16.) and 2 *Thirds*, and abſolves his *motion* about the *Planet* in 12 *Days*, 4 *Hours*, and 27 *Minutes*. The *ſecond* was long before detected by HUGENIUS, and is much more bright than the former; and is diſtant from the *Center* of *Saturn*, 4 *Diameters* of the ſaid *Ring*, and turns round him within the ſpace of 16 *Days* and 23 *Hours*. The *third* was firſt obſerved by CASSINUS, in the year 1671, towards the End of *October*, at his furtheſt digreſſion from *Saturn*. But ſoon after he vaniſh'd out of ſight, and did not appear again till the 15*th* of *December*; and preſently after diſappeared, until about the beginning of *February* 1673, when he continued in ſight for 13 *Days* together.

X. *What is the Cauſe of the variation of Light, which is obſerved in the laſt Satelles of* Saturn.

No other Reaſon ſeems aſſignable for this great variation of *Light* in this laſt *Satelles*, than that ſome part of his *Body* doth ſtrongly reflect the *Light*, whereas the other cannot do ſo. According as we ſee it happens in the *Globe of Earth*, where that part which is cover'd with *water*, is not fit to reflect the *Sun-beams*; whereas the other parts of it ſend them back every way. This *Satelles* therefore either is rolled about his own *Center*, or elſe is carried about *Saturn*, as the *Moon* is carried about the *Earth*. And therefore when that part of him, which is like the *Continent* of our *Earth* is turned towards us, then we ſee him, and he vaniſheth again from our *ſight*, when that part which is of the Nature of *Sea*, faceth the *Earth*.

XI. *Why* Saturn *appears under different figures.*

They who firſt obſerved *Saturn* with a ſhort and imperfect *Teleſcope*, were aſtoniſhed when they perceived him ſometimes of an *Oval figure*, ſometimes as having 3 *Bodies*, that is, with 2 other added to the middlemoſt; ſometimes ſolitary and perfectly round. But when theſe unlook'd for *Appearances* had ſtirr'd up others to the viewing of this *Planet*, ſome making uſe of more exquiſite *Inſtruments*, found, that thoſe which before were taken to be the *Lateral Globes*, were in the *figure* of *Handles* or *Arms*, that is, hollowed out and bent, ſo that joyned to the middle *Globe*, they conſtituted a *figure* not unlike a *Weavers-ſhuttle*. But at laſt, by the uſe of the moſt abſolute *Teleſcopes*, it was found that this *Planet* hath a round *Body*, as all the reſt; but hath this peculiar, that it is encompaſt, as it were, with a broad *Ring*, not much unlike the *Brim* of a *Hat*, when the Head is out of it; or that of a *Diſh*,

Dish, when the bottom or hollow is taken away. And therefore this *ambient Body*, which before was called the *Handle* or *Arms* of *Saturn*, was since called the *Ring*.

In order to the explaining of this *Appearance*, we must represent to our selves this *Planet*, as a great *Globe*, resembling that of the *Earth*, and in which we conceive 2 *Poles*, an *Equator*, and a *Torrid Zone*; and that round about the said *Torrid Zone* there is elevated an opake Matter, which fills the space of a considerable breadth, and is disposed in the *figure* of a *Ring*, resembling that broad *Circle* we call the *Horizon*. This being thus supposed, it is certain that we must of necessity see *Saturn*, according as he appears at A, when we view him from a place that is much higher than the Level of the *Ring*; afterwards he must appear to us, as at B, or at C, when we behold him from a place where we are not so high as the said *Level*. And last of all he must appear altogether round to us, as at D, when we are so placed with respect to his *Body*, that if his *Ring* were continued, it would pass through our *Eye*; for then the inconsiderableness of the Thickness it hath, by reason of its great distance, makes it altogether invisible. To which may be added, that probably we fail of seeing this *Ring* of *Saturn*, because this *Planet* passing over against some *fixt Star*, and having deprived us of the view of it by one of the *Tops* of the *Oval* G, in the *Figure* A, the said *Star* will afterwards be seen at the place E, where we see a kind of *Blackness*, which is nothing else but the defect of the *Circle*, and a part of the *Heaven*, which offers it self to our view, by that space which remains betwixt the said *Ring* and *Body* of *Saturn*.

Figure 15.

CHAP. X.

Of the Spots about the Sun, and the fixt Stars.

I. *The Sun viewed through a Telescope, appears dark and shaded.*

THo' the *Sun*, to an unassisted *Eye*, appears bright, and to have an uniform Aspect; yet when we make use of a *Telescope*, with 2 *Convex-Glasses* in the *figure* of *Lentils*, it doth represent such a vast variety of *bright* and shaded *Bodies*, as if it were nothing but a continued Checker-work.

This various mixture in the *Body* of the *Sun*, is not caused by the foresaid *Glasses*, as some have feigned, supposing that they, by reason of their Impurity, might represent *shadows* to our *Eyes*: Because when those *Glasses* are turn'd round, the *Solar spots* are not turned round with them, but keep their former situation: And moreover those of these *spots* which one day are seen towards the *East*, in the following days move forwards and are seen towards the *West*. These *spots* therefore of the *Sun*, are generated from those *striate Particles*, which entring through its *Poles* do run towards the *Center*; from whence, because of their irregular *figures*, which they have got by passing the *Triangular spaces*, they are expell'd, as not being able to comply with the motion of the *subtil Matter*, which whirls round in the *Sun*'s *Center*, and are cast off like Scum from a *boyling Liquor*; so that being endued with rugged and many *Corner'd figures*, and running round more slowly than those which wheel about with the *Sun*, they become easily entangled and grow to a great bulk, which being contiguous to the *Sun*, and lying upon the *face* of it, do cover and involve it with Darkness.

II. *These Spots are Fumes proceeding from the Sun.*

It seems very probable, that as *Steams* do proceed from the *Body* of the *Earth*; so likewise *Fumes* and *Vapours* do exhale from the *Sun*, and are dissipated again, like those that *sublime* from the *Earth*. For tho' the whole *Sun*, at some time may be altogether free from any *spots*; yet is he frequently so beset with them, that GASSENDUS hath observed no less than 40 of them; yea, they sometimes increase to that bulk, as to be visible without a *Telescope*; which hapned not only at the time of CHARLEMAIN, but also of late years, when KEPLER took one of those *spots* to be the *Planet* of *Mercury*.

III. *Why sometimes the outward parts of these Spots be bright and shining, and the middle parts dark.*

The Out-parts of the *Spots* are sometimes *bright*, and represent several *Colours*; when in the mean time their *Middle parts* continue still *opake*.

This proceeds from the *Matter* of the *Sun* that surrounds these *spots*; for tho' probably all of them may at the beginning be of the same thickness, and equally resist the *Light*; yet it may so happen, that afterwards they may be more extenuated in the *Circumference*, than in the *midst*; and by this means the *Sun-beams* being refracted through these thin brims of the *spots*, do exhibit several *Colours*; whilst all this while, the middle of them continues *opake* and impervious to the *Solar Rays*. Because the most *subtil Matter*, which is predominant in the *Sun*, and in every *fixt Star*, hath not force enough to transmit its own Action, because its strength is broken by meeting with the *soft parts* of *Matter*: Or, if by chance the *Heavenly Globuli*, being whirl'd about by the force of the *Matter* of the *first Element*, endeavour to withdraw from the *Center*, and to communicate the *Action of Light* to our *Eyes*; yet is not that impulse strong enough to affect the *Sense*, except it be accompanied with a continual pressure of the *Sun* and *fixt Stars*, such as may be sufficient to overcome this Reluctancy, and dispose it for the reception of the *Action of Light*.

IV. *The Spots of the Sun are more frequently perceived about the Ecliptick, than about the Poles.*

These *Solar spots* are more commonly discerned about the *Ecliptick*, than towards the *Poles*, according to the unanimous Assertion of most *Astronomers*; some whereof have been so acurate in the description they have given of their progress, as to declare that these *spots* move about the *Rim* of the *Sun*, not in perfect parallel Lines to the *Ecliptick*, but with an inclination towards 3 *Degrees and an half*.

The Cause of this Appearance is, that tho' the *Particles*, whereof these *spots* be composed, have Action enough, when they proceed from the *Eclipticks* of other *Vortexes*, to pass through the *Poles* of the *Sun*, and to be carried towards its *Ecliptick*; yet when they are once mingled with the most *subtil Matter* of the *Sun*, not being able to comply with the most swift agitation thereof, are flung off towards the *Heaven*, where the *motion* is not so swift; as before hath been said concerning the *Scum*. Now the Reason why they are rather expell'd towards the *Ecliptick*, than towards the *Poles*, is this, because the new Matter, which

which continually enters through the *Poles* of the *Sun*, thrusts out the *striate Particles*, and all others that are easily entangled together, and drives them upwards. For the better clearing of this, let us suppose 2 *Rivers* flowing from opposite Points, the *one* from A to S, and the other from B towards the same S; and that their *Streams* meeting at S, and driving each other forward, make a deep *Hole* or *Whirl-pool*, *d e f g*; where, after having performed several *Circulations*, they continue their *Course* towards M and Y. Besides, let us suppose that by this forceable meeting of these *Streams*, much *Froth* is produced, which swims on the top of the *Vortex* S, and follows the motion of the *Water*: We shall easily apprehend, that this *Froth* cannot tend to A or B, that is, towards the *Poles*; but after having taken some compasses in the said *Whirlpool*, will take its Course towards M and Y, that is, towards the *Ecliptick*.

Figure 16.

V. *The Spots of the Sun are sometimes changed into Torches, and Torches sometimes into Solar Spots.*

The *Spots* of the *Sun* are sometimes changed into *Torches*; and those Parts which before were dark and misty, appear bright and shining: And, on the contrary, these *Torches* are sometimes turned into *Spots*.

The cause of this Change is the *Ebullition* of the *Sun*, whereby it continually casts out some of its parts, and soon after swallows, or takes them in again. For *Spots* are turned into *Torches*, when the *Solar matter*, which flows about them, is raised above their *Rims*, and by exerting its force upon them, does produce that Action, which reaching our Eyes, produceth that which we call *Light*. For seeing that the *Matter* of the *Sun* is intercepted between the *spots* themselves, and the *surface* of the Neighbouring *Heaven*, the swiftness of the *motion* is increased, because of the narrowness of the Space; which therefore must render the *Light* of the *Sun* more intense. As we find by Experience in *Rivers*, whose swiftness is increased, and becomes more strong, the narrower the Channel is, or when straitned by great *Stones*. But *Torches* are changed into *Spots*, and those which before were the more bright parts of the *Sun* become darkned, when that more *subtil Matter*, which lay upon their *surfaces*, is swallowed up by the *Sun*, into the room whereof, when abundance of *New matter* comes, whose *particles* cling together, they produce a close and dark *Body*.

VI. *What the Reason is, why the Sun hath for some days been without Light.*

Histories assure us, that the *Light* of the *Sun* hath been frequently intercepted to that degree, that his *Light* did not much exceed that of the *Moon*. Yea, what is more, *Histories* tell us, that in PLINY's time, the *Sun* for 12 Days together was not to be found; and that when CONSTANTINE had his *Eyes* put out, it did not shine for 17 Days together, and that Darkness cover'd the *Earth* all that while.

I suppose, that no more proper Cause can be assign'd for this Obnubilation, than the *Spots* which at these several times did *beset the surface of the Sun*, and hinder the diffusion of his *Light*. For tho' these *spots*, at their first Gathering, be very *soft* and loose *Bodies*, which are able to break the force of the most *subtil matter*; yet the Matter of the *Suns* Substance, continually beating against them, makes them *smooth* and *hard*, whilst the other part of them, which is turned towards the *Heaven*, still continues soft and loose, as before. And therefore they cannot without difficulty be dissolved, because the *Matter* of the *Sun* doth continually rush against the inside *surface* of them; but rather increase continually, as long as these their Edges, which are raised above the *surface* of the *Sun*, are not made hard by the constant pushing of the said *Matter*. And therefore whenever this happens, it cannot seem strange, that one and the same *spot* should so spread it self over the *surface* of the *Sun*, as to intercept the Light of it, not only for many Days, but also for some Months.

VII. *How these Spots come to appear of divers figures.*

These *Spots* sometimes appear of an *Oval*, and sometimes of some other *figure*, when they move in the utmost Circumference of the *Suns Body*.

The Reason is, because there they must needs appear less, when their Illuminated part is invisible to us, and the lesser dark part is only perceived by us; but the more they approach towards the *middle* of the *Sun's Round*, and in a right Line to our *Eye*, so much the *greater* and *rounder* do they appear to us. Another Reason also of their different Appearance, may be the various *Configuration* and Disposition they have amongst themselves, as when some of them happen to meet in the same Line of our Sight, and by this means do in part hide one another, for then they appear of a kind of *Oval figure*. And forasmuch as many of them do frequently thus meet together, and are afterwards separated again; it so happens, that some of them seem to us to be generated, and others again to be destroy'd or vanish; which then comes to pass, when *spots* of different *Magnitudes* and *Distance* (some of them moving more swiftly, and others more slowly) do hide one another; and when some of the lesser of them, and that are nearer to the *Sun*, are by degrees *Eclipsed*, and afterwards again uncover'd, and so appear, as before.

CHAP. XI.

Of Spots that appear in the Orb of the Moon.

I. *Of the Perpetual and Temporary Spots in the Moon.*

THere be 2 sorts of *Spots* perceiv'd in the *Moon*, some are *perpetual*, and which from the beginning have appeared in it, as proceeding from the make and disposition of her Parts: And others *Temporary*, which only are about the *surface* of her *Body*, and after a short time vanish and disappear again. The *Perpetual spots*, do always appear of the same dark and dusky *Colour*; and which way soever they be posited, with respect to the *Sun*, do always retain the same degree of Obscurity, and are much darker than those *spots* that are *temporary*.

This *Phænomenon* proves, that there is a great affinity betwixt our *Earth* and the *Lunar Globe*, and that like *Bodies* are found in them both. For we cannot imagine these constant or perpetual *spots* to be any thing else, but *Seas* which are diffused over the *Body* of it. For it is evident, that the *Light* reflected from *Water*, is much weaker than that which is reflected from the *Earth*, or any other *solid matter*; as we may see in our *Sea*, which doth not appear of a *white*, but of *blewish*, or *Sea-green Colour*. We observe also,

that *white things*, when moiſtned, do become more obſcure, and draw towards a *black Colour*. Let but ſome *Water* be ſpilt upon a *Floor* (to make uſe of GALILÆUS his *Example*) and preſently the moiſtned *Bricks* will appear of a *darker Colour* than the reſt, becauſe the *water* filling their *pores*, makes their *ſurfaces* plain and even; which conſequently do unite the *Rays*, and direct them to one Point only. And ſeeing that fewer *Rays* are reflected from a *Convex ſurface*, than from one that is plain, the *Light* which from the *Moon* can be reflected to our *Eyes*, muſt be ſo inconſiderable in quantity and ſtrength, as not to be ſo much as one 14000*th* part of her *Diameter*.

II. *What the Reaſon is of thoſe bright parts which ſometimes appear in the Moon.*

The *Moon* has ſome parts which are much brighter than the reſt, and which do ſo ſtrongly affect our *Sight*, as that they ſeem to be very diſtant from one another. Whence GASSENDUS tells us, that *about the 3d or 4th day after the New Moon, we may for the moſt part obſerve, beyond the lower point of her Body, at the diſtance of about a 27th part of her Circumference, a certain bright Point, and ſometimes alſo a 2d and a 3d, at a greater diſtance, whilſt the Intervals betwixt them continue ſtill in obſcurity.*

Theſe Appearances give us good ground to conclude, that there be *Mountains* in the *Moon*, ſeeing that with the aſſiſtance of a *Teleſcope*, the Ridges of ſeveral of them are perceived very bright, which caſt a moſt thick *ſhadow*, and that greater or leſs, according as thoſe Eminencies are more or leſs diſtant from the Confines, which ſeparate the enlightned part of the *Moon* from the dark. For it is obſerved, that theſe ſhadows *decreaſe*, according as the Illumination is increaſed, until that they do altogether vaniſh away upon the diffuſion of the *Light* over the whole *Hemiſphere*. And after that the *Lunar Beams* are come to the other *Hemiſphere*, the ſame Ridges or Tops of *Mountains* do appear again, and caſt their *ſhadows*, but towards an oppoſite Point. Which Appearances afford us an inconteſtable Proof, that the *Moon* hath her *Mountains*, as well as our *Earth*, whoſe Tops are illuſtrated by the *Sun*, and ſhed a great *Light*, whilſt in the mean time her lower and more depreſt parts, continue obſcure and dusky.

III. *Whence proceeds that appearance of a Face, which is ſeen in the Moon.*

About the 6*th* day of the *Moon*, towards the Weſtern part of it, there appears the *Face* of a *Man*, with a broad *Fore-head*, a crooked *Noſe*, a wide *Mouth*, and *Eyes* deep ſunk.

This Appearance is cauſed by ſeveral *Spots*, that are depreſt between the foreſaid Prominences. For ſeeing that the *Mountains* in the *Moon*, do far exceed ours in height, they accordingly project great *ſhadows*, which renders their *Intervals* dark and obſcure, and makes them look like *ſpots* reſiding in thoſe places. This we find by Experience in the *Mountainous* parts of the *Earth*, which are thick ſet with *Trees*, and therefore appear more dark than bare and open *Fields*; becauſe the *Trees* make a great *ſhade*, and hinder the *Rays* from proceeding further. Thus foraſmuch as not only *Rocks* and *Banks* are diſcover'd in the *Moon*, but alſo very high *Mountains*; the *ſhadows* which they caſt, may be ſo ranged as to repreſent the *Fore-head*, *Noſe*, *Mouth*, *Eyes*, and *Lips* of a Man, but very deformed: Seeing that it cannot be queſtion'd, but that the even or plain parts of the *Moon*, which lye between the *Mountains*, are dark and reflect no Light at all towards us; and that therefore the *ſpots*, which repreſent to us the parts of ſome deformed Countenance, do not proceed from the *Tops* of the *Mountains*, but muſt rather be attributed to their *Intervals*, between which the *ſhadows* are projected.

IV. *Why the Face of a Man, rather than any other figure, is perceived in the Moon.*

But if any one enquire further, how it comes to paſs that when we behold the *Moon*, we ſeem to ſee the *Face* of a *Man*, with *Eyes*, *Noſe*, *Mouth*, &c. when indeed there is no ſuch thing there.

To this I anſwer, that no other Reaſon can be aſſign'd for this Appearance, ſave only that the Footſteps or Traces of a *human Countenance*, are ſo deeply impreſt in our *Brain*, from our frequent, and almoſt continual beholding of the *Faces* of *Men*; that the *Animal ſpirits*, which have their Rendevous in the *Brain*, not being able to penetrate the other parts of it, becauſe of their Reſiſtance, are eaſily turned aſide, by the direct *Light* of the *Moon* impreſt upon them, and made to betake themſelves to thoſe Traces, to which the *Idea's* of a *human Face* are linked by Nature. And tho' others ſeem to behold in the *Moon*, a *Man ſtanding*, or any other Appearance, this is only to be attributed to their *Imagination*, which having been ſtrongly impreſt by ſuch like Objects, have ſome Traces left in it, which are eaſily open'd again, by any thing that hath the leaſt reſemblance with them.

V. *Why the Moon increaſing, appears with Teeth like a Saw.*

The *Moon increaſing*, being look'd upon through a *Teleſcope*, doth appear rugged and, as it were, with *Teeth* like a *Saw*; as if in the very confines of the Luminous part of it, there were ſome rugged and uneven *Bodies*, that did terminate that part of its *ſurface*.

The Reaſon is, becauſe the *Sun* being then newly riſen, and only darting his *Rays* ſide-ways, doth caſt *ſhadows* towards the oppoſite part. And becauſe this *Section* of the ſhadow is very unequal, becauſe of the great variety and multiplicity of the *Mountains* againſt which the *Solar Rays* are reflected, the Face of the *Moon* muſt needs appear uneven and jagged.

VI. *Why the Moon at the Full doth appear bright all over.*

No *ſpots* or *ſhadows* are diſcerned in the *Moon*, when ſhe is at the *Full*; yea, thoſe very parts which appear'd very black at the time of her *Conjunction*, do at the *Full Moon* appear moſt bright and refulgent.

The Reaſon is, becauſe all the parts the *Moon* then diſcovers to us, are illuminated by the *Sun*, who being directly oppoſite to her, doth enlighten all her moſt abſtruſe parts: Or, if any of her parts, by reaſon of their bending downwards, continue unenlightned, the ſame are cover'd by ſome nearer Parts, which turned towards us and them, and ſo do not appear to us at that time. To which may be added, that thoſe *Intervals* which before were ſhaded, do not only at the *Full Moon* receive the direct *Rays* of the *Sun*; but alſo the *Beams* which are *reflected* from the ſides of the *Mountains*, by which *reflexion* all the parts of the *Moon* cannot but appear white and refulgent to our *Eyes*.

CHAP.

CHAP. XII.

Of Comets.

I. *Comets run through ſeveral Regions of the Heavens.*

Comets obſerve no certain Tract in the *Heavens*, but perform their Courſes ſometimes through *this*, and ſometimes through *another* part of them. For ſome do firſt appear at the *Sun*'s *riſing*, others at his *ſetting*. The *Comet* which appeared in the Year 1585, was almoſt directly oppoſite to the *Sun*, and wanted but little of receiving his *Rays* directly: Whereas another that appeared in 1607, was firſt ſeen about the *Bear*, when the *Sun* was near the *Winter Tropick*.

The Cauſe of theſe Appearances will be evident to us, if we conſider that *Comets*, are *Stars* cover'd with *ſpots*, and ſwallowed up of other *Vortexes*. Now, foraſmuch as they may happen to fall into any Quarter of the *Heavens*, accordingly they may ſometimes paſs through one, and at other times through another part of the *Heaven*; neither is there any part through which they may not take their courſe at ſome time or other. The place therefore of the appearance of *Comets*, is very uncertain, ſeeing that they promiſcuouſly may paſs by the *Stars* of any *Aſteriſm*. So that *Comet* which appeared in 1618, did ſeem to come forth from the Rays of the *Riſing-Sun*; when as others have been ſeen to appear from under the *Beams* of the *Setting-Sun*.

II. *Why ſome Comets move towards the Eaſt, others towards the Weſt.*

Comets ſeem to move every day, from Eaſt to Weſt about the *Earth*; becauſe the *Earth* moves the quite contrary way. But yet foraſmuch as their own proper motion is *indeterminate*, thoſe which come from a *Vortex*, which is towards the Eaſt, ſuppoſing they can continue their *motion*, will move towards the Weſt; and thoſe which proceed from a *Vortex* towards the *Weſt*, muſt conſequently move twards the *Eaſt*; yet with this Circumſtance, that when they have once taken their *determination* towards the *Eaſt*, or towards the *Weſt*, their *Courſe* is every whit as exact as that of the *Planets*; for after having 2. or 3 times calculated their *Diurnal motion*, it is eaſie to compoſe an *Ephemerides* of their whole Courſe, and to know as perfectly the *degrees* of their ſwiftneſs and ſlowneſs, as we know all the degrees of *Heaven*, through which they are to take their progreſs, and their various Configurations with the *Stars*.

III. *Why the Comets vaniſh at laſt.*

From what hath been ſaid, may be gather'd the Reaſon why a *Comet* at firſt appears greater, and afterwards continually decreaſeth, until its total diſappearance: For ſeeing that *Comets* receive their Light from the *Sun*, after that they are paſt out of our *Vortex*, they can no longer appear to our *Eyes*.

IV. *The Time of the Continuance of Comets, is uncertain.*

Comets have no time prefixt to their *motion*: For ſometimes many years paſs without the appearance of any of them; and at other times many are ſeen in one and the ſame year: As *Hiſtorians* tell us, that in the *year* 1618, there appeared no leſs than 3 or 4.

Foraſmuch as *Comets* proceed from ſeveral *Vortexes* into ours, it is very difficult to determine, whether their Appearance be fortuitous and caſual, or regulated and neceſſary: But howſoever it be, we are to conſider it as fortuitous, becauſe all the Obſervations that have be been made hitherto about this Matter, are not over exact. And if ſo be that *Comets* do never begin to appear in the *Zodiack*, it is without doubt, becauſe the motion of our *Vortex*, which is very rapid in that part of it, makes their entrance that way more difficult, or, it it may be, altogether impoſſible.

V. *Why Comets do generally appear under the ſame Magnitude.*

Comets do generally appear under the ſame *Magnitude*, inſomuch as that being beheld through a *Teleſcope* (if we will believe the Aſſertions of ſome) they do not appear greater, than when beheld without it.

The Reaſon is, becauſe they are ſo far from us, that one and the ſame *Comet* may be perceived at the ſame time by ſeveral Spectators, tho' at a vaſt diſtance from one another, and that without any *Parallax*. So that they are probably concluded to be in that vaſt Space which is ſuppoſed to be betwixt *Saturn* and the *fixt Stars*. For the *Comets* are ſuch vaſt *Bodies*, and are moved with ſuch extraordinary ſwiftneſs, that they ſtand in need of that immenſe Space for the performing of their Courſes; neither can any other places be aſſigned, wherein they can conveniently abſolve them.

VI. *Comets being in the higheſt Heavens, cannot have any Parallax.*

But how can it be, may ſome ſay, That *Comets* being beheld by *Spectators* with a vaſt Tract of the *Earth* between them, ſhould exhibit no *Parallax* or variation of Aſpect? This difficulty will be fully cleared by the *Figure*. For ſuppoſe we that ſome *Luminous Body* A, or F, placed in the lower part of Heaven, ſhould be beheld by 2 Perſons at a diſtance, D and B, at the ſame time; then will the *Luminous Body* A, which is ſeen by the *Spectator* D, appear over againſt the *Luminous Body* E; and the *Luminous Body* F, ſeen by the other, will appear over againſt the *Luminous Body* H. But the ſame *Luminous Body* A, when perceived by another Perſon at a diſtance B, will appear to him about the *Luminous Body* C. And the *Luminous Body* E, ſeen at the ſame time by the Perſon B, will be diſcover'd by him over againſt the *Body* G. And thus the *Aſpects* of theſe 2 *Bodies*, A and F, according to their different ſituation, will produce a greater or leſs *Parallax*, as is C and E, or G and H. But if the *Luminous Body* be placed in the upper part of *Heaven*, about I; it will appear to both Perſons, at a diſtance from each other, in the ſame place, that is, over againſt the *Luminous Body* K.

Figure 17.

VII. *Why the Comets do vaniſh after a few Months appearance.*

Comets, after a few Months or Days, do diſappear and vaniſh. And therefore PLINY determines their longeſt appearance to 185 Days: Seeing that which was ſeen in *Nero*'s time, and was lookt to be of the longeſt continuance of any other, was conſpicuous only the time of 6 Months, tho' in all that time it ſcarce run through the one half of *Heaven*.

The Reaſon whereof is, becauſe *Comets*, by paſſing from one *Vortex* to another, are driven towards the Circumference of them, becauſe of their ſolidity: And tho' they every where retain the ſame degree of Celerity; yet becauſe they have more Agitation, than to be ſtopt by the Matter of the *Vortex*, through which they paſs, they ſlip into a Neighbouring *Vortex*, much like a *Ship*, which being carried contrary to the Stream of a *River*, doth in ſome degree comply with the motion of the *River*, but is at laſt driven to the *Shoar*.

Thus

Thus a *Comet* Courſing it ſometimes through this, and ſometimes through another part of *Heaven*, doth continually keep it ſelf at a diſtance from the *Center* of the *Heaven*, wandering only in the *Circumference* of it; and ſo by this means it comes to leave our *Heaven* within a few Days or Months, and paſs into others which are inviſible to us. Wherefore, if we meaſure the Space which the *Comets* run through, we ſhall ſeldom perceive it to reach the half of a *Circle*, and that moſt frequently it doth not exceed the quarter of one. And if at any time it happens, that their Appearance is continued 4 Months, or longer, this is becauſe they enter into our *Vortex*, near the *Poles* of it, where they find the Matter leſs agitated.

VIII. *Comets move much more ſlowly towards the End of their Courſe, than at the beginning of it.*

Comets about the beginning of their Appearance are moſt ſwiftly moved, and but ſlowly towards the end of it; according to the account which *Aſtronomers* give us of that which appeared in 1572; which at the beginning of its *motion*, proceeded 5 *Degrees* every day, and towards the End thereof ſcarcely *Half a Degree.*

The Reaſon hereof muſt be fetched from the diſtance of the *Comets*; for tho' *Comets* by paſſing through the Extremities or utmoſt parts of the *Vortexes*, do always keep the ſame degree of ſwiftneſs; yet becauſe at firſt they have run a good way of their Courſe before we ſee them, by reaſon of the Matter they bring along with them, which too much refracts the *Rays of Light*; and then do by little and little move towards other *Vortexes*, and withdraw from our ſight, therefore their Courſes appear more ſlow towards the end of them. After the ſame manner as when we ſee a *Traveller*, paſſing on his way with the ſame pace, as long as he is not at any conſiderable diſtance from us, we perceive no difference in his gate, until he be come to a greater diſtance, when he appears to us to move more ſlowly; not becauſe of his moving ſo indeed, but becauſe of his greater diſtance from us.

IX. *The Motion of Comets appears ſwifter in the middle of their motion.*

Tho' *Comets* move more ſwiftly, when they firſt enter into any *Vortex*, than after that they have been there for ſome time; yet is the midſt of their Courſe *ſwifter* than any other parts of it; becauſe being then in their *Perigæum*, or place neareſt to the *Earth*, they are alſo in thoſe parts of the Line they deſcribe, which are neareſt to the *Earth*: Whereas, when they are at the beginning or end of their *Courſe*, they are about thoſe parts of the ſame *Line*, which are the moſt remote from us. To this we muſt add, that when a *Comet* at the ſame time is in his *Perigæum*, and his oppoſition with the *Sun*, his *motion* muſt appear much more ſwift, becauſe he is then nearer to us by the whole quantity of the *Excentrick* of the *Earth.*

X. *What is the Cauſe of the Tail and Beard of Comets.*

Comets commonly ſhed *Hairs* from them, eſpecially on that ſide which is oppoſite to the *Sun*: But after a various manner; for ſome drag a *Tail* after them, others have a long *Beard*, others repreſent a *Roſe*, by having theſe Hairs ſcatter'd round them.

This variety proceeds from the different *Heavenly Globuli*, that are found in our *Heaven.* For we ſuppoſe thoſe that are near to the *Center* of our *Vortex* to be leſs, but that they increaſe by degrees, as they draw nearer to the Orb of *Saturn*; which after they have once paſt, they are all of them equal, and whirl'd about with the ſame degree of ſwiftneſs. Foraſmuch therefore as *Comets* are carried in the utmoſt parts of the *Vortex*, and borrow all the *Light* they reflect to us from the *Sun*, it follows, that thoſe *Beams* of *Light*, which are communicated by the greater of thoſe *Globuli*, by that time they come to the leſſer, do not only paſs according to Right Lines, by which, as being the chiefeſt, the *Head* of the *Comet* is ſeen by us, but are alſo refracted and diſperſed ſide-ways. As if a *Veſſel* ſhould be ſo fill'd with *Bullets*, as that the great ones did lye upon the leſſer, we ſhall find, that upon boring a Hole at the bottom of the *Veſſel*, the greater *Bullets* lying at the top, muſt in their deſcent preſs upon more of the leſſer, and drive them down to Right Lines. And the ſame thing is obſerved in *Comets*: For ſeeing that the *Sun* is much about in the midſt between the *Comet* and the *Earth*, his *Rays* beating againſt the *Comet*, and ſcatter'd on every ſide of it, do produce the *Hair* of it: But when the *Earth* withdraws from the *Right Line*, which joyns the *Centers* of the *Sun* and a *Comet*, then the *Beams* of the *Sun* which are reflected towards us, do repreſent the *Body* or *Head* of the *Comet*; and thoſe which are diffuſed towards the Edges of it, do repreſent its *Beard* or *Tail.* Which are called by either of their Names, as they either go before, or follow the *Body* of it.

XI. *How Comets come to appear with Tails, Hair, or Beams like Roſes.*

The *Figure* will fully clear this Point. Let the *Sun* be S, the *Circle* through which the *Earth* runs in a *Years* time, 2, 3, 4, 5, according to the order of the ſaid *Ciphers.* The term or limit from whence the *Globuli* begin to grow leſs and leſs, D E F G, and the *Comet* in our *Heaven* C. It is apparent that the *Rays* of the *Sun* darted againſt this *Comet*, towards all the parts of the *Circle* D E F G H, are in ſuch a manner reflected thence, that thoſe that fall perpendicularly upon F, do moſt of them tend towards 3; but ſome of them are ſcatter'd this way and that way; and thoſe which fall obliquely upon G, do not only tend directly towards 4; but are in part refracted towards 3: And laſtly, that thoſe which fall upon H, do not reach directly to the *Circle* of the *Earth* 2 3 4 5, but being reflected, tend towards 4 and 5. Whence it is evident, that when the *Earth* is in the part 3 of her *Orb*, the *Comet* C will appear to thoſe that view it from thence, with *Hair* ſcatter'd on all ſides of it, which ſort of *Comets* are commonly called *Roſes:* For the *Rays* that come directly from the *Comet* C, to 3, do repreſent the *Head* of it; and the weaker, which proced from E and G, towards 3, do afford the appearance of its *Hair.* But if the *Earth* be at 4, then the ſame *Comet* will be perceived by the *ſtrait Rays* C G 4, and its *Tail* will appear directed only to one part, by the *Rays* that are reflected from H, and other places between G and H, towards 4. And in like manner, when the *Earth* is at 2, the *Comet* will be perceived by means of the direct *Rays* C E 2, and the *Hair* of it by the oblique *Rays*, which are plac'd between C E 2, and C D 2. Neither will there be any difference, ſave that when the *Spectator* is placed at 2, the *Comet* will appear in the Morning, with

Figure 27. in the Inſtitutions.

with its *Hair* going before it, but to the *Spectator* placed at 4, the *Comet* will appear in the Evening, with a *Tail* trailing after it.

XII. *Why none of these appearances are ever perceived in the Planets.*

The Reason why the *Planets* never appear with *Tails*, *Beards*, or *Hair* scattered round them like *Comets*, is because the *particles* of the *2d Element*, which encompasseth them, are not big enough to make *Beams* that enlarge and divide themselves into many others; whereas those that are about the *Comets*, are always big enough for that purpose.

XIII. *Whether Comets presage future events.*

Comets are commonly look'd upon as the forerunners of great *Calamities*, and are supposed to presage *Storms* and *Tempestuous Weather*, *Devastations*, *Famine*, *Wars*, *Death of Princes*, *Plague*. Thus the *Comet* that appeared in VESPASIANS time, is said to have presaged his *Death*; others the taking of *Rome* by ALARICUS; the Murther of the Emperour MAURICE, and destruction of MAHOMET; the Death of CHARLEMAIN; the irruption of the TARTARS into *Silesia*, and the cutting off of the Inhabitants *Ears*.

Such Stories as these are common amongst the *vulgar*, and believed also by many who think themselves much wiser than their Neighbours. But if we examine the matter, we shall find that the appearance of these *Stars* had no connexion at all with the things that hapned soon after their appearance. For if *Comets* be the signs of *Wars*, the death of *Princes*, &c. Why do these ever happen without the foregoing presages? Why do *Kings* die, *Famin* and *Plague* prevail, when no *Comets* at all have discovered themselves to give warning of these accidents to the *World*? True it is, that these events are sometimes ushered in by *Comets*, but more frequently happen without them.

Moreover, seeing that *Comets* pass about the *Earth*, how is it that they foretell *Overthrow* and *Destruction* to some, *Succes* and *Victory* to others? Probably indeed we might be induced to own this power in *Comets*, if *Kings* only died when they appeared; if they could distinguish between persons, or if they only *aspect* Great-Men. But since we always find the *Funerals* of *Princes* and Great-Men, accompanied with so many thousand of vulgar Exequies, have we not great reason to conclude, that they have no greater force or influence upon the former, than upon these latter?

XIV. *The Affairs of Men are covered with great darkness.*

But some Body will say; it is certain that these kind of *Stars* are sometimes sent by God to denounce some calamity or other to the *World*. Be it so, for I will not deny it; but by what Argument can it be proved, that the appearance of a *Comet* is to denounce this or the other particular event, rather than another? Has GOD ever by Revelation made known to us, that when a *Comet* moves towards the *West*, it denotes danger from things Foreign and without; and when to the *East*, danger from within? It is sure enough, that the *Comets* have no Power over us, and that it is only our Folly or Ignorance that makes us affraid of them.

CHAP. XIII.

Of the Productions of the Stars.

I. *How the Sun is said to be the Author of the works of Nature.*

IT hath hitherto been the common belief of most *Men*, that the *Stars* govern these inferiour things; and by an universally diffused *Virtue*, preside over *Human Affairs*. Hence it is that they have attributed Heat to *Mars*, Cold to *Mercury*, Moisture to the *Moon*, as supposing their Dominion chiefly to consist in these qualities, and that they impart these to all their inferiour *Subjects*. Therefore it is that they call the *Sun*, the Parent of the *Universe*, and the Great *Artificer* of all Natural *Works*; because they find that his presence imparts Life and Vigour to all *Natural Things*, as his absence, on the contrary, is the cause of their *failing*, *wasting* and *Death*.

Some Fancy *Influences* in the *Sun*, by which he concurs to the production of all *sublunary things*. But would they diligently give heed to the *Suns Action*, they would find him to have no other but that of *Illumination*; or if they meet with any other, that they are reducible to it, as to their original. For that the *Sun* doth *heat*, *dry* and *burn* Bodies, proceeds from this Act of *Illumination*, which produceth these various effects according to the different disposition of the *Subjects*.

II. *How the Sun may be said to be the Cause of moisture and cold.*

If any one say that *Cold* and *Moisture*, wherewith *Bodies* are affected, cannot be derived from the *Sun*.

I Answer, That these also by accident do proceed from the *Sun*; forasmuch as during his absence, the *moisture* is no more discust and extenuated, and therefore the *Vapours*, either by their abundance, or by supervening *Cold*, become condensed, and moisten.

III. *How the Sun produceth fair weather and tempestuous.*

The *Sun* is the Cause of the *Tempestuous* and *Fair Weather*; and therefore when he is about the midst of *Sagittary*, upon the dissolution of those *humours* which before were bound up, and the *Earth* being watered with them, he produceth fruitful *Western* Winds: He stirs up the forces of the *Pleiades* and *Hyades* in *Taurus*; those of the *Kids* towards the *North*; those of his Neighbour *Orion* towards the *South*; and of *Arcturus* over against him, which stir up *Southern* blasts, and for some days together, do moisten with *Rains* the sown *Seeds*.

These and the like effects do not proceed from the *Sun*, as from a *special Cause*, but only as from a *General*, who diffusing his *Rays* every where, and promiscuously illuminating all *Bodies*, is not determined more to this effect, than to another. But if the *Sun* produce *stormy Weather* in one part of the *Earth*, and *Fair* in another, this is not so much to be attributed to him, as to the *situation* and *disposition* of the several parts of the *Earth*, which receiving his *Beams* after a different manner, are differently affected by them. For that we, for instance, have a pleasant *Summer*, and that our *Antipodes*, at the same time, suffer an unpleasant and sluggish *Winter Season*, doth depend on the *Sun*, who with a constant and even Course runs through the *Zodiack*, and uniformly diffuseth his *heat*. Who will say that the *Sun* is the Cause of *Tempests* and *Fair Weather*; when at the same time, he is the same on this side, or beyond the *Equator*? The reason therefore why

the *Sun* doth more copiously impart his *Light* and *Heat*, when it is *Summer* with us, is to be imputed to the *situation* of the *Earth*, that we tread upon, and which makes the difference between us and the *Antipodes*, with whom it is *Winter*; but not all to the *Sun*, to whom it is meerly accidentary, that they are *cold*, whilst we have *heat*, or who darts his *Beams* obliquely upon them, whilst he is perpendicular to us.

IV. *In what sense the Stars are said to be for Signs and Seasons*

Neither doth it contradict any thing that we have said, what the *Scripture* declares concerning the *Sun*, *Moon* and *Stars*, that they were to be *for Signs and Seasons, and for Days and Years.* Because these things are no otherwise signified by the *Stars*, than by the *Swallows*, who by their coming and going, do presage the *Spring* and *Winter*; or as *Rainbows*, *Lightning*, *Darkness* and other changes of the *Air*, do indicate *Showers*, *Thunder* or *Fair Weather*. For as *Swallows* are not the Cause of the *Spring*, nor the *Rainbow* of *Fair Weather*, but only signs of either of them: So neither is the *Dog-Star* a cause of the great *Heats* we have at the latter end of *Summer*, but only a sign of the time wherein they happen. As shall be declared hereafter.

V. *Whether the Moon hath any Dominion over Sublunary things.*

The *Moon* contributes very much to the changes we have here below, for she not only raiseth violent *Winds*, excites *Storms*, and reduceth condensed *Vapours* into *Rain*; but moreover doth make Seeds to grow, and ripens the *Fruits* of the *Earth*, and encreaseth or lesseneth moisture, according as she encreaseth, or is in the wane.

Tho' all these things pass with the most of People for *indubitable*, yet we have good reason to affirm, that they are taken up without sufficient ground or reason; because *Storms* are raised, *Showers* moisten the *Earth*, and *Plants* encrease and ripen, as well when she is opposite to the *Sun*, as when she is in her first, or last Quarter; except we should say that she hath the power by the weak light she draws from the *Sun*, of moving or stirring those *humours*, which she is not able to discuss, and therefore is said to foment and encrease them. But let that *virtue* be what it will, sure it is that it cannot with any reason be ascribed to her, seeing that it belongs only to the *Sun* as a General *Cause*; who by his *Beams* produceth all the vicissitudes of *times* and *things*, which we see here on *Earth*. Hence are those Rules of *Astrologers*, that *Millet* should be sown in *April*, whilst the *Sun* is in *Taurus*; and *Wheat* in *October*, when the *Sun* riseth together with *Scorpius*, and when the *Pleiades* sink out of sight, as the same is elegantly described by *Virgil*, in the first Book of his *Georgicks*.

And Millet then your Annual care awakes,
When Taurus *Golden-horns open the Year;*
And Syrius *leaves to other Stars the Sphear.*
But if for Wheat and stronger Corn, thy ground
Thou exercise, and but a Crop propound;
First let the Eastern Pleiades *go down,*
And the bright Star of Ariadnes *Crown:*
Commit due Seed to Furrows then, and here
Trust Earth with hope of the ensuing year.

Hence it is that the *Poets* call *Orion*, *Stormy* or *Tempestuous*; the *Vergiliæ* or *Pleiades*, *Showery* or *Cloudy*, because upon their appearance the *Seas* are troubled with Storms, and the *Earth* with Rainy and Cloudy Weather. I do not deny but that the *Stars* may be said to be the Signs of changes of *weather* and *seasons*; but by no means the *Causes* of them, as if by their Influence and Activity *Plants* did grow, and attain their Maturity; but only point out those times, wherein the *Sun* is more favourable to the growth of *Corn*, or when the Sea is most subject to Storms.

VI. *The Dog-star hath no virtue for the producing of Heat or Diseases.*

The *Dog-star* excites extream *heats*, and is sometimes so malignant, as to produce dangerous and *Epidemical Diseases*.

But this event is to be resolved as the former; for this intense *Heat* doth not proceed from the *Dog-star*, as if there were any virtue in him, to cause, and excite some extream *hot Spirits*, proper to inflame and destroy the healthful temper of mens *Bodies*: But because this *Star* doth arise at that time, when the *Sun* by his nearness to the *Earth*, doth very much dry up its moisture, and draw forth those exhalations, which infecting the *Air* first of all, do afterwards communicate the same corruption to *Bodies*. Hence it is that the *Air* at *Rome* is at that time counted very unwholsome, because the Country thereabouts abounds with may *Caves* and *Holes*, whence the *Sun* raiseth many *exhalations* that are very prejudicial to health. But it is evident, that these *effects* cannot be attributed to the *Dog-star*, because that *Constellation*, when the *Heat* is at the height, is not advancing towards our *vertical point*, but withdrawing towards that of our *Antipodes*, and therefore ought rather to affect them, than us. For this is common to all *Stars* and *Constellations*, that they affect most those parts of the *Earth*, on which they dart their more direct *Rays*. Which since it doth not happen in the *Dog-star*, and that our *Antipodes*, at that time, are oppress with Cold, when our Climate is scorcht with Heat; we may safely conclude, that the *Heats* we are sensible of, at that time, do not proceed from the *Dog-star*, but that there is a quite different Principle to be assigned for our heat.

VII. *It is absurd to ascribe acute Diseases to the Dog-star.*

How absurd it is to attribute Acute *Diseases* to the *Dog-star*, is evident from hence, because whereas that *Constellation* about 2000 years since, did arise about 23 or 24 days after the *Solstice*, that is, about the *7th* of *July*, of our Style; it is still supposed to rise at the same time; whereas indeed the *Dog-star* doth not rise now till a month after, by reason of the motion of the *Fixt Stars* towards the *East*, according to the order of the *Signs*. And notwithstanding *Acute Diseases*, *Fevers*, &c. are commonly attributed to the former term, beginning at the *7th* day of *July*. But who can believe that those extream *Heats*, we are sensible of in *July*, will ever be translated to *January*? When yet it is most certain, that after 10000 Years, if the *World* continue so long, the *Dog-star* will arise about that time.

VIII. *The Planets do not contribute to the Moisture or Drought of Sublunary Bodies.*

The Virtue and Efficacy of the *Planets* are proved by certain *Experiments*; as that some of them influence *Cold*, others *Heat*; some under such an Aspect communicate *Moisture*, and under another *Drought*. Whence is that of PLINY, *When the Grass and Herbs are grown, and that they stand in need of more Moisture, whereby they may arrive to their full growth and perfection*; *the* Sun *by entring the Constellation of* Cancer, *doth furnish and supply the same.*

This

This alſo, in a good Senſe, may be ſaid to be falſe and erroneous; for ſeeing that all the *Planets*, act only by the light which they borrow from the *Sun*, and that they reflect nothing but it, there can no diverſity of *Effects* be inferr'd from the variation of it. For all that can be gathered from their Conjunction with the Sun, is only this, that the *Air* is Hot in *Summer*, and Cold in *Winter*. But as to what Weather it will be the next Year, when the *Sun* ſhall enter this or the other *Houſe*; when the *Dog-ſtar* ſhall ariſe; or when *Arcturus* ſhall ſet; whether the *Winds* will be boiſterous; whether we ſhall have a hot *Summer*, cannot with any certainty be known from any preſage that can be taken from the *Stars*; ſince it frequently happens that the very Seaſons of the Year are confounded, ſo as that we have cold *Summers*, clear and mild *Winters*, a hot *Spring*, and *Winter-like Autumns*. For the *World* is not governed in ſuch an exact and ſetled order, but that great alterations happen in the Seaſons of it, and make it look as if it were governed by hap and chance.

IX. *The Stars have no Power over Sublunary things.*

Conclude we therefore, that no *Stars*, beſides the *Sun*, who acts only by his *Light* and *Heat*, have any influence on things here below: And that therefore it is a vain thing for *Aſtrologers* to predict *Wind* or *Rain* from the Poſition or Aſpects of the *Moon*, or from the ſame indication to preſcribe the taking of a *Potion*, or *Blood-letting*, or to determine that it will be good or bad *Sailing Weather*; that *Trees* are to be planted, *Flowers* and *Herbs* watered in the encreaſe of the *Moon*. From all which notions, I queſtion not but men will be delivered, by conſidering their vanity, and that they are only grounded on ſuch ſuppoſitions, the truth whereof can never be proved.

CHAP. XIV.

Of the Predictions of Aſtrologers.

I. *Whether* Thales, *by the help of Aſtrology, foretold the Dearth of Oyl.*

IT is a thing notorious, that THALES the *Philoſopher*, was skilful in *Aſtronomy* and *Aſtrology*; and that from this Knowledge of his, he was aſſured of a Dearth of *Oyl*, which came to paſs accordingly.

Tho' this be a Story, commonly avouched by *Aſtrologers*, to maintain the *Glory* of their *Science*, yet it may eaſily be made out, that he did not conjecture this from any Rules or Precepts of *Aſtrology*, but from his continual Study of Nature. For being a great *Natural Philoſopher*, and being well acquainted with the virtue and efficacy of *Water* (which he maintained to be the *Principle* of all *things*) he could not be ignorant what *Fruits* ſtood in moſt need of *moiſture*, and how much they were beholden to *Rain* for their growth and increaſe; and in what *ſeaſon* of the *Year* they thrive beſt. All theſe things he might eaſily know without the *Precepts* of *Aſtrology*, they being ſuch, as no *man*, skill'd in *Natural Philoſophy*, can be ignorant of. But if they will needs have it, that *Thales* foreknew this by his Skill in *Aſtrology*, why do not they do as much, who pretend to be ſo well vers'd in the ſaid *Art*? How comes it to paſs that they are always *poor*, if they, by their Skill, have the ſame opportunities of enriching themſelves which *Thales* had? But the caſe is plain, that they themſelves cannot truſt the Truth of their own *Principles*, and are affraid of ſpoiling their Credit, by a too peremptory aſſertion of any thing that is built on them.

II. *Reaſons that prove Judicial Aſtrology to be vain and falſe.*

And not without good Reaſon: For 1*ſt*, They are not certain of the Nature and Virtue, even of thoſe *Stars* that are moſt known. 2*dly*. Becauſe the *Nature* and *Virtues* of moſt of the *Stars* are utterly unknown to them; which unknown *Virtues* may variouſly change and alter the operations and effects of thoſe *Stars* that are known. 3*dly*. Becauſe they can give no *Reaſon*, why a *Figure* erected for a Childs *Nativity*, to gueſs at his *Fate*, *Manners*, &c. muſt be taken from the time of his *Birth*, rather than from that of his *Conception*. 4*thly*. Foraſmuch as the Aſpects of the *Stars* are greatly changed in a ſmall moment of time, by reaſon of the incredible ſwiftneſs of their *motion*; how will any *Mother* or *Midwife* be able ſo exactly to determine the very juſt moment of the *Childs Birth*, ſo as to make the *Aſtrologers Judgment* true and certain, which cannot be pretended, except the exact point of time be given him. Beſides, 5*thly*. We find that thoſe perſons, who were born and conceived at the ſame moment of time, are found to have different *Natures*, *Manners* and *Deſtinies*: And that perſons of both *Sexes*, of all *Ages*, and born under ſeveral *Aſpects* of the *Planets*, and in different *Countries*, do periſh at the ſame moment of time by *Earthquakes*, falling of *Houſes*, taking of *Cities* or *Shipwracks*. 6*thly*. I would demand of theſe Men that are for Influences, whether *Diſcipline*, *Learning* and *Good Education*, or *Divine Providence* it ſelf have no influence upon the Manners of *men*, to oppoſe and countermine this force and efficacy of the *Stars*?

Probably it was for theſe, or the like reaſons, that *Aſtrologers*, *Magicians* and *Diviners*, were by a moſt ſevere Edict of the Emperor *Tiberius*, baniſhed out of *Rome*, and all *Italy*, according to the account *Dion* gives us, *Lib.* 57.

III. *Whence the Stars took their Names.*

Neither is it of any conſideration in this caſe, that the *Ancient Poets* have put the names of *Bears*, *Lions*, *Perſeus*, *Hercules*, &c. upon the *Conſtellations*; foraſmuch as this was not done by them, becauſe they ſuppoſed them to have any particular influence upon *Bears*, *Lions*, &c. but only in commemoration of ſome ſtrange and wonderful accidents, or to celebrate the memory of ſome of their *Antient Heroes*, and their Atchievements: In the ſame manner as GALILÆUS not long ſince, gave the name of the *Mediceæan Stars*, to the ſecundary *Planets* by him diſcovered about *Jupiter*; not becauſe of any *Medicinal Virtue* he ſuppoſed to be in them, but in honour to the *Great Duke of Tuſcany*, whoſe Name is *de Medicis*.

IV. *Many have had their Death foretold them by Aſtrologers, but without any certainty.*

Many have had the time of their *death* foretold to them: Thus SENECA makes mention of a certain perſon, who being told by an *Aſtrologer*, that his *Death* was at hand, went home, and 2 days after died.

To which I anſwer, that this effect doth not prove the *Truth* of the *Prediction*; for tho' a *Prognoſtication* be never ſo vain and ungrounded, yet it may ſtrike ſuch a fear into the perſon to whom it is declared, as may cauſe his Death to follow thereupon: For a perſon in this Caſe, finding himſelf altered and diſcompoſed with the fright, he preſently imagines, that this Illneſs is the ſure fore-

runner

runner of his *Death*, and so kills himself by the strength of his Imagination. How many have by this means hastned their own ends, and have died for fear of *Death*? For it is not always the greatness of the Evil we suffer that troubles or torments us, but the conceit we have taken of it. Who doth not deride ARCHELAUS, who, according to what *Seneca* tells us of him, at the time when the *Sun* suffered an *Eclipse*, commanded his Palace to be shut up, and had is *Sons Hair* cut off; which was never done but in sign and token of the extreamest *Grief* and *Calamity*? Or who would not deride the superstition of the *Thebans*, who shouted, beat upon *Brass Instruments*, and rung *Bells*, to rescue the *Moon*, whom they supposed that some *Witches* were, by their *Charms*, about to pull down from her station in *Heaven*? For people commonly are not so much troubled with things, as with the *Opinions* and *Imaginations* they have taken up concerning them.

V. *Various things seem to have been truly foretold by some Astrologers.*

But some will say, that at least it cannot be denied, but that *P. Nigidius*, the *Astrologer*, foretold to *Augustus*, that he should be Lord of the *Earth*, and the Successor of *Julius Cæsar*. *Scribonius* declared concerning *Tiberius*, when he was yet an *Infant*, lying in his *Cradle*, that he should come to the *Empire*; and after having overcome manifold difficulties, should be the Sovereign of the *World*. *Largius Procilus* determined the day of *Domitians* Death; and *Ascletarius* fixt the manner of it; who being thereupon demanded by the *Emperour*, whether he knew what kind of *death* he should die himself, answered that he should be torn to pieces by *Dogs*: Whereupon the *Emperor* to prove him a *Lyar*, and to expose the vanity and groundlesness of his Predictions, commanded him presently to be burnt; which being put in Execution, as he was burning, a suddain storm of *Rain* falling, extinguish'd the *Fire*, whereupon the *Dogs* falling upon the half-burnt Body pulled it to pieces and devoured it.

To all which I Answer, 1*st*. That we have ground to question the Truth of many of these Relations; not that I would make the veracity of all *Historians* doubtful, or suppose them to have inserted Lies, on set purpose into their *Relations*; but because I conceive them to have been too apt to give credit to the Report and Talk of the Common People, especially about those Rumours that were spread abroad concerning the *Birth* or *Death* of their *Kings* and *Emperors*. 2*dly*. It is a thing notorious beyond dispute, that many of them did by all means endeavour to please and flatter their *Princes*; which they had no better way to do, than by inventing some things they knew would be grateful and acceptable to them; as by shewing that they had been by GOD elected and appointed to the *Government*; that they should be prosperous in their *Reign*, and enjoy long *Life*, and lasting felicity.

But that I may not seem to be too injurious to *Historians*, let SENECA speak instead of me; who living at the same time with them, was fully acquainted with their Manners and Temper. *Neither*, saith he, *need we take much pains to invalidate the Authority of* Ephorus: *For, to say no more, he is an Historian*: *And how many are there of these, who hunt for praise, by relating of things strange and incredible; and stir up their Readers Appetite (who should they relate common and ordinary things only, would never think them worth the reading) with some prodigy or miracle? Some of them are credulous, others are negligent; some of them are overtaken with Lies, others are pleased and delighted with them. Some do not take the care they ought, to avoid all falsities, and others desire them; and this may be said in common of them all, who think their Work will never be approved of, or become Popular, except it have a sprinkling of Lies. And as for* Ephorus, *it is well enough known, that he is not a Writer of the most Religious Veracity, but that he is often deceived himself, and as oft deceives others.*

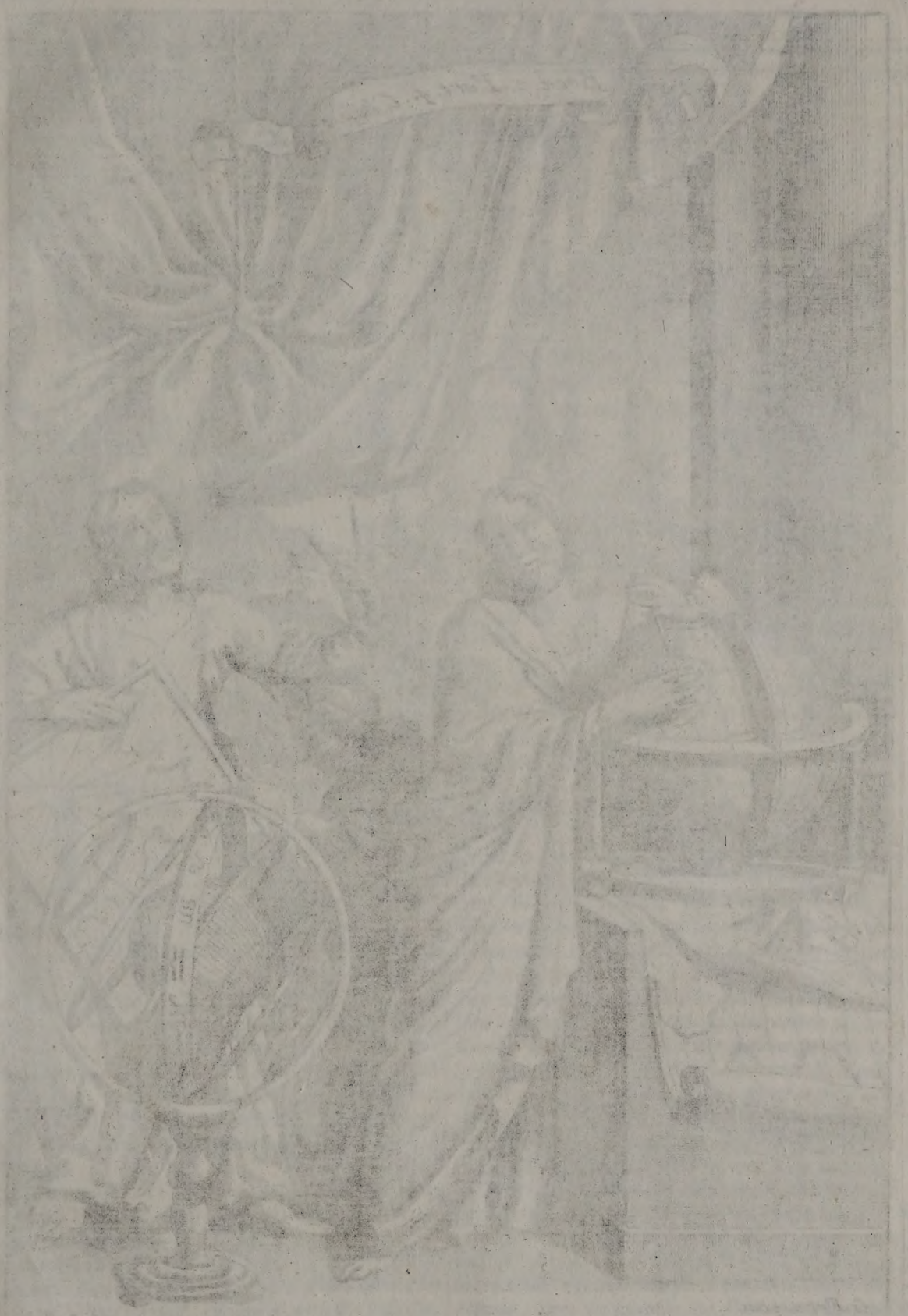
Indeed it may easily be proved, that many *Historians*, besides EPHORUS, have both deceived others, and been deceived themselves, in their *Relations* concerning *Augustus*. For seeing that *Augustus* could not be possest of the Empire, till after the Death of *Cæsar* and *Pompey*, of whom the *Chaldæans* had foretold, that they should die, not by violent Deaths, the one in the *Senate*, the other in *Egypt*, but in their own Houses, and full of Years and Glory; how can we give credit to them, seeing they pronounce things contrary? And whilst they stumble upon one Truth, pronounce many Lies, and are deceived in all the rest?

VI. *How Ascletarion might foreknow Domitians Death.*

But they will further urge the instance of *Ascletarion*, who precisely told the manner of *Domitians Death*, and his own too; Whence had he this, but from the *Stars*?

I will not here alledge the Opinion of several *Authors*, who have look'd upon this whole story of *Ascletarion*, as one of those Fables that run amongst the Vulgar. But shall only hint this one thing, that *Ascletarion* might foreknow the Death of *Domitian*, without any assistance from his skill in *Astrology*, and that by very certain and unerring signs. *First*. For that *Tyrants* are hated by all men, and that few of them die in their Beds. 2*dly*. He knew that many did lie in wait for *Domitian* to kill him, and that he was every way surrounded with Enemies. But as to what he foretold of himself, that he should be torn to pieces by Dogs, this he could not foreknow, but by mear guessing at a venture; and therefore it seems most probable, that this was only a fiction superadded by the Common People, to make the Story look more strange and wonderful; seeing that the most skilfull *Astrologers* do not extend their Predictions beyond Death; and therefore it is probable that *Ascletarion* supposed not that his *dead Carkass* should be devoured by *Dogs*, but that *Domitian* would have exposed it to be torn to pieces alive by *Dogs*, for a punishment of this Boldness, in foretelling his *Death*. And if so, it is apparent he was mistaken, and that the Predictions of *Astrologers* are vain and uncertain; or if any thing they prognosticate comes to pass, it is only by chance and conjecture. Such were the foolish Prognostications of a certain *Astrologer*, who from the condition of the *weather* on *New-years-day*, would determine the Fate and State of the whole following *Year*. But who is so sensless as to believe such stuff as this, or to amuse himself with groundless Conceits and Imaginations?

The



Book. 2. Part. 4. Chap. 1.
G. Freman Inv.
I. Kip Sc.

The Fourth Part OF THE HISTORY OF NATURE. OF EARTH, WATER, FIRE and AIR.

CHAP. I.

Of the Globe of Earth.

I. *Why the Earth, as containing the Water, is called a Terraqueous Globe.*

THE *Earth*, forasmuch as it contains in its Cavities the *Waters*, and together with them constitutes one *Globe*, is called the *Terraqueous Globe*.

For when we take a *Voyage* by *Sea*, sailing in the *Atlantick Ocean*, and passing through the *Magellan Straits*, towards the *South Sea*, and so on to the *East* and *Æthiopick Seas*, we find that all these *Seas* are encompast with *Shores*. And in like manner, when we travel by *Land*, we shall find the *Land* bounded, on one side with the *Atlantick* and *Æthiopick Seas*, and on the other with the *South Seas*; and again, this way with the *Eastern* and *Arabian*; and that way with the *Tartarian*, *Atlantick* and *Æthiopick Seas*.

II. *The Earth is but a Point, compared with the vast extent of Heaven.*

Tho' the *Earth* be of that vast extent, that its compass is of about 7000 *French Leagues*; or according to the later investigation of WILLOBRORDUS SNELLIUS, of 24624 *Miles*: Yet if we will believe *Astronomers*, it is no more than a Point, compared with the vast *Circumference* of *Heaven*.

Neither is this Assertion of theirs without ground: For so great is the distance betwixt the *Earth* and the fixt *Stars*, that it cannot be certainly determined, as exceeding all Calculation; and can scarcely be apprehended by our *Imagination*. The distance of the *Planets* may be discerned by their *Parallax*, or that variation of Aspect they afford to several *Spectators* in distant places; but the *Fixt Stars* are at so prodigious a distance, that no *Parallax* is to be found in the beholding of them, and the *Semidiameter* of the *Earth*, with relation to them, is as nothing. So that if some one of us should be supposed to continue in the place of the *Earth*, whilst it was carried up towards *Heaven*; there is no question, but at its first rising, it would shew like a vast *Globe*; but as it mounted higher, would still decrease to our sight; till being got up as high as *Jupiter*, it would appear no bigger than one of the lesser *Stars*; and rising higher towards the *Fixt Stars*, would become invisible to us. And therefore the *Earth* which contains so many *Seas*, so many *Kingdoms*, so many *Islands*, yet is no more than a *point*, with respect to the *Heavens*. Yea, when compared to our *Vortex*, which hath the *Sun* in its *Center*, we shall find it so inconsiderable, that they who make *Sundials*, suppose the top of the Pins of them to be placed in the *center* of the *Earth*, whence they cast their *shadows* upon the *surface* of it; as if the difference were so small, that it comes to the same thing, whether they cast their *shadows* from the *Center*, or the surface of it, the distance being so very inconsiderable in comparison to the *Suns* distance.

III. *How vain Men are, that make such pother and fighting about a silly point of Earth.*

This may give us an estimate of the folly of Men, who for one point of *Earth*, wage so many *Bloody Wars*, yea, for the 1000*th* or 1000000*th* part of it. This forsooth, as PLINY saith, is the matter of our *Glory*. Here we enjoy our *Honour*; here we exercise our *Dominion*; here we have our *Riches* and *Possessions*; here mankind continually Bustles, Toyls and Turmoyls it self; here we wage *Wars*, and soak the *Earth* with one anothers *Blood*; and our *Swords* destroy our own kind. But not to speak now of the publick feuds, and fury of whole *Nations* against each other: Here it is that we endeavour to lay one clod of *Earth* to another; and after having purchased all the poor pittances of our *Neighbours* about us, what a brave purchase have we made after all? And what great Reason have we to boast in being Possessors of not so much as the thousand thousandth part of a point? But this is to sing a Song to a *Deafman*; return we therefore to our *Earth*.

IV. *How the Earth hangs poiſ'd in the Air, without any thing to ſupport it.*

The *Earth* hangs in the midſt of *Heaven*, without any *Pillars* to uphold it; and, as if it were immoveable, doth ever keep the ſame diſtance from the *Heavenly Orbs*.

This happens to the *Earth*, not becauſe it is the *Center* of the *Univerſe*, as it is commonly ſuppoſed, and that all the *Celeſtial Orbs*, are rolled about its Circumference: For ſhould we grant this to be, yet would the difficulty ſtill remain, why the *Earth* does not reel from its place, why it doth not either mount upwards, or fall down. For if it be *Heavy* by Nature, how comes it to paſs that it doth not ruſh downwards? If it be *Light*, why does it not fly upwards? Conclude we therefore, that the *Earth* doth hang poiſ'd in the *midſt of the Air*, by means of the *ſubtil matter*, which continually whirls round it, and pierceth all the *pores* of it. For ſeeing that the *Heavenly matter*, which on all ſides ſurrounds the *Earth*, is whirl'd about it with one and the ſame degree of Swiftneſs, which far exceeds that wherewith the *Earth* is moved, it cannot but hinder it from falling, or mounting higher. For as *Birds* are upheld by the *Air* from falling; ſo the *Earth* and the *Moon*, which circulate in the ſame *Vortex*, are ſupported by the ſame Matter that carries them along, and hindred from Reeling any way from their *Centers*.

V. *Why the Earth, by its weight, doth not come nearer to the Sun.*

The *Earth*, notwithſtanding its weight, yet is not driven to the Circumference of the *Sun*'s *Vortex*; but being kept within its bounds by the *Heavenly Globuli* that ſurround it, continues at a certain diſtance, *viz.* in the midſt, between *Mars* and *Mercury*, without paſſing any further.

The Reaſon is, becauſe the *Planets*, amongſt which the *Earth* is, by reaſon of their different degrees of *ſolidity*, are more or leſs removed from the *Center* of their *Vortex*: So that *Saturn*, who is at the greateſt diſtance from the *Sun*, is more ſolid than all the reſt. And the *Earth*, tho' it ſeem to be a cloſe and compact *Body*, yet is not of that *ſolidity*, as to ſway it more towards the Circumference of its *Vortex*; foraſmuch as *Mars*, who is much leſs than the *Earth*, yet is alſo more ſolid, by reaſon of the cloſer entanglement of its parts. For tho' the *Earth*, as to its *ſurface*, be very compact and ſolid, yet with reſpect to its bulk, it may well be accounted light; becauſe the *ſurface* of it is not above 2 or 3 Mile in thickneſs, which is very inconſiderable, if compared to thoſe vaſt *Cavities* it hides within its Bowels. And therefore as *little Ships*, ſuch as have no great force, are eaſily kept in the *River*, and carried by its *motion*: So likewiſe the *Earth*, being fallen into the *Vortex* of the *Sun*, always keeps the ſame place, in which, by reaſon of its ſolidity it is ranged, and cannot be puſht any further towards the *Circumference* of the *Sun*'s *Vortex*.

VI. *The Magnetical virtue of the Earth, doth but weakly affect Iron.*

The *Earth* communicates a *Magnetick* force to *Iron*; but the ſame is ſo weak, that it eaſily loſeth it, and admits the contrary. Thus when we turn the End of a *Bar* of *Iron*, as yet not endued with any *Magnetick virtue* towards the *Earth*, immediately in that End which is inclin'd towards the Ground, it will obtain the force of the *Southern Pole* in theſe Northern parts, which in a moment it will loſe again, and obtain the contrary; if that End which was towards the *Earth* be turned upwards, and the other End inclined downwards.

The Reaſon whereof is the weakneſs of the *Magnetick force* that is in the *Earth*: For ſeeing that the *ſtriate Particles*, which proceed from out of the *Earth*, do return thither again through the inner *Cruſt* of its upper *Region*, whence the *Metals* are dug up, it ſo happens that very few, or none of them return through our *Air*; thoſe only excepted, who do not find a Paſſage in the ſaid inner *Cruſt* open for them. Hence it is that *Load-ſtones*, that have fit *pores* for the reception of the ſaid *particles*, have alſo a greater force to attract *Iron*; becauſe the *ſtriate Particles* meet with *pores* in the *Load-ſtone*, which are ranged in like manner, as are thoſe of the inner *Cruſt* of the *Earth*: Whereas, when they paſs through the *Air*, or through other *Bodies* of the outward *Cruſt* of the *Earth*, where they find no ſuch *pores*, they move with more difficulty, and conſequently alſo fewer of them come to us.

VII. *They who Travel from North to South, find the Northern parts to be withdrawn from their ſights.*

Perſons that Travel from *North* to *South*, find that the Northern parts of *Heaven* ſink lower and lower, and by degrees withdraw from their ſight; but they who paſs from *South* to *North*, do find the Northern parts of *Heaven* to be raiſed higher; ſo that after having Travelled 73 *Italian miles* in length, or 24 common *French Leagues*, the *Northern Pole* will be raiſed a Degree higher.

This Experiment proves the *Earth* to be *Round*; for if the *Earth* were *plain*, no ſuch Change could be perceived. For tho' we ſhould ſuppoſe a Man to be plac'd directly under the *Pole*, yet would there be no change in the elevation or height of the *Pole*; for if he ſhould withdraw from it in a *Right Line*, the depreſſion will not be equal, nor after he hath Travelled onwards 73 Miles, would he find one *Degree* left behind, but the withdrawing will become ſtill leſs and leſs, becauſe of the continual decreaſing of the *Angle*: So as that at laſt 73 *Miles* would ſcarcely make a depreſſion of 1 *minute* of a *Degree*: Which is contrary to daily Experience.

VIII. *The Mountains do not hinder the Roundneſs of the Earth.*

The Roundneſs of the *Earth* is not hindred by thoſe high *Mountains* that are found on the *ſurface* of it, many of which riſe much higher than the *Clouds*, as *Olympus*, *Athus*, and the *Peak* of *Teneriff*. Becauſe the Roundneſs that is attributed to the *Earth* is not *Mathematical*, as if the Lines drawn from the *Center* to its *Circumference* were all perfectly Equal; but only *Phyſical*, that is, ſuch a Roundneſs, as is ſuitable and convenient for the Univerſe; foraſmuch as theſe *Inequalites* are of ſo great moment, that they do not come into any conſideration, when compar'd with the vaſt amplitude of the *Body*. For ſeeing that the *Semidiameter* of the *Earth*, is of 860 *miles*, the proportion of the greateſt height of the *Mountains*, to the *Semidiameter* of the *Earth*, will be as one 1 to 860. And foraſmuch as there be but very few *Mountains* that are perpendicularly ſo high, and that the moſt of them are ſcarcely one Quarter of a Mile in Height, it is evident that they can no more ſpoil the *Roundneſs of the Earth*, than ſome ſmall Unevenneſſes in the *Round Balls* made by *Artificers*, do hinder their being Round. For indeed, there is not a *Body* to be found in the whole Univerſe that is perfectly and abſolutely Round, that is, which hath an exact *Geometrical Roundity*.

This

IX. *The Variation of the Altitude of the Pole, proves the Roundness of the Earth.*

This *Physical Roundness* of the *Earth* may be demonstrated by the following Experiment: When a Man travels *North* or *South*, he will find the Altitude or Elevation of the *Pole* to vary continually, whether he go a Plain-way, or Up-hill and Down-hill: So that if being at the Foot of a *Mountain*, and having observed the Elevation of the *Pole*, he Travel the whole day towards the *South*, he will not perceive the Elevation of the *Pole* to be increased, but rather decreased, by that time he comes to the top of the said *Mountain*. Neither will he in like manner find the same *Altitude* decreased, but diminished, if having taken the Elevation of the *Pole* at the top of the *Mountain*, he goes down again to the bottom of it. Which is an evident Proof, that the *Devexity* or bending downwards of the *Earth*, is every where perceptible; and that a perpendicular falling upon any different Points, whether of *Acclivity* or *Declivity*, do all tend downwards by different Lines, that will meet at last in the *Center*.

CHAP. II.

Of Water.

I. *Water is more hard to be congealed, than Oil.*

WE daily Experience, that *Water* is more difficultly congealed than *Oil*, and that it never is frozen without there be a vehement Cold in the *Air*: Whereas *Oil* is apt to congeal in any place, where the *Air* is only inclining to Cold. And, on the other hand, *Water* is sooner turned to *Vapours* than *Oil*, if they be both exposed to the *Sun*, or set over a *Fire* of the same *heat*.

The Reason why *Water* is fluid, and doth not so easily congeal as *Oil*, is, because it hath *smooth* and *slippery parts*, like *Eels*; which tho' they lye close, and be entangled together; yet they never stick so close, but that they may be easily separated again. Whereas *Oil* consists of Parts which are easily entangled, and stick fast and close together: Which is the Reason why *Oil* is not so easily resolved into Vapours, as *Water*, the parts whereof, by the agitation of the *subtil matter*, are easily separable and hang but loose together.

II. *Why Water will not easily mix with Oil.*

From hence it appears also, why *Oil*, or *Air*, cannot, without great difficulty, be mingled with *Water*; because their *parts* do more easily joyn together, than with the *parts* of this: For if you beat *Water* and *Oil* so long together in a *Vessel*, till they appear as one and the same *Liquor*; yet cannot they continue so long, but that the parts of *Oil* meeting again with one another, will cling together, and form several Drops, which being carried to the top of the *Water* by their Lightness, will there continue, whilst the parts of the *Water*, at the same time, do likewise run together into *Drops*, and so by their weight fall down to the bottom of the *Vessel*.

III. *That Water is not Cold, as Aristotle would have it.*

From what hath been said, may likewise be gathered, that *Water* is not *cold* of its own Nature, according to ARISTOTLE's Opinion, seeing that it admits *heat*, and doth not let it go, but by imparting it to the *Air*, which is colder than it. We find also, that when a River *freezeth*, the *Ice* begins at the Top, that is, in that part which is touch'd by the cold *Air*: Which would not happen so, if the *Water* were cold of its own Nature; for then it would begin to *freez* either in the midst, or at the bottom; or at least would *freez* as soon in the midst, as at the top; which yet is contrary to Experience.

IV. *Why Wine is frozen sooner than Water.*

And for the same Reason it is, that *Wine* is not so easily congealed as *Water*; because in the *Wine* there be many *subtil particles*, easily moveable, and which are swiftly and readily agitated by the *Celestial matter*, which because of their subtilty are called *Spirits*. And therefore it is, that by how much stronger the *Wine* is, so much the harder it is to be *frozen*; and that the *Spirit of Wine*, when freed from its *Phlegm*, doth elude all the extreamest force of *Cold*. And accordingly it hath been found by Experience, that if a *Vessel* of some Rich *Wine* be exposed to the *Air*, in extream *Cold weather* the *watry part* of the *Wine* will be frozen, and the *Spirits* will continue liquid and fluid in the Center of it.

V. *A Man under Water, doth not feel the weight of it.*

The *weight* of *Water* is not felt at the bottom of a *River*: Which is a thing experienced by *Divers*, who are not prest down by the *water* that lies upon their *Heads*; but are as much at liberty for all that, as if they were in the free and open *Air*.

The Reason whereof is, because no more of the *water* doth exert is gravity upon the *Body*, than would descend, in case the *Body* did remove out of its place. For suppose we a *Man* placed at the bottom of the *Vessel* B, and lying in such a manner with his *Body* on the Hole A, as to hinder the *water* from running out of the *Vessel*, he will find that the whole weight of the *Cylinder* of *water* A B C doth lye upon him, the *Basis* whereof I suppose to be of the same bigness with the Hole A; who, if he himself should pass down through the Hole, the whole *Cylinder* of *water* would descend likewise; but if we should suppose the *man* placed somewhat higher at B, so as not to hinder the Egress of the *water* at A, then would he no longer perceive any weight of the *water* which lies upon him between B and C; because if he should sink down towards A, yet the *water* would not fall down with him; but on the contrary, that part of the *water* which lies under him towards A, to the same bulk as his *Body* is, would come up into his place: Whence it appears, that the *water* rather carries him upwards, than bears him down, as may be proved by the Example and Experience of *Divers*. For which Reason also it is, that they cannot reach the bottom of the *Sea*, without some weight hung at their *Feet*. Figure 18.

VI. *Things weighed, that are found to be of equal poise in the Air, do lose the same when weighed in the Water.*

For the same Reason it is, that *Bodies* which being weighed in the *Air*, are found to be of Equal weight, do lose the same *equality* when they are weighed in the *water*. Thus when *Lead* and *Copper* being weighed in the *Air*, are found of equal weight, if they be weighed under *water*, they lose the same: Because the *Lead* takes up less place in the *water*, than *Copper* of the same weight does; and therefore in *water* it must needs preponderate, tho' in the *Air* it was of equal poise with the *Copper*.

VII. *How water comes to putrefie or corrupt.*

Water, if it stands still without *motion* for a while, or if it be kept close in a *Vessel*, doth putrefie and stink.

The Reason is, because tho' some small quantity of *Salt* and *Sulphur* be found in *water*; yet, because upon its standing still, they become loosed from

from the union they had with the parts of the *water*, and run together, they conſequently do eaſily evaporate, and thereby cauſe Putrefaction. Whereas, as long as the *Water* continues in *motion*, the *particles* of the *Salt* and *Sulphur*, are mixed with thoſe of the *water*, and by this means become entangled, and are hindred from flying away, and leaving the *water* deſtitute of that which doth preſerve it from Putrefaction.

VIII. *Why the Water ſinks, or riſeth higher in a Veſſel.*

Water contain'd in a *Glaſs-Veſſel* or *Tube*, without filling it to the top, appears lower in the *midſt*, than at the *Sides* or *Edges*. Whereas, on the contrary, if the ſaid *Veſſel* be fill'd to the very top, it will appear ſwell'd and higher at the top, and inclining to a *Spherical figure*.

The Reaſon is, becauſe the *Air* preſſeth down the middle part of the *water* on every ſide, in a *Veſſel* that is not quite full; whereas it only preſſeth the outſides of it more obliquely. But when the *Veſſel* is full of *water*, beſides that the *water* is more firmly cloſed in the *Veſſel*, its middle parts are only drawn together by the *Air* that lies above them; whereas the Extream parts are compreſt, as well by the *Air* that is above them, as by that which is on the Edge or Brim of it.

IX. *What is the Cauſe of the Roundneſs we find in the Drops of Water.*

The *Drops* or *Bubbles* that are ſeen in *water*, are Round; but as ſoon as they touch others, they unite, and are confounded with them.

The Reaſon of their Roundneſs, is the equal *preſſure* of the ambient or encloſed Air. For a Drop of *water*, being, as it were, pois'd on its point of Contact, is equally preſt on all ſides by the Circum-ambient *Air*. And as ſoon as it toucheth another Drop, becauſe the preſſion in the place of Contact is thereby weakned, it preſently becomes joyned with it. And therefore it is, that thoſe hanging Drops, which are, as it were, ſupported every where, and ſurrounded by the *Air* that doth encompaſs them, are driven that way, where there is no *Compreſſion*; that is, towards that part where they reſt upon ſolid *Bodies*. And if you touch a hanging Drop, at the lower part of it, it immediately follows; becauſe the *Air* doth not preſs at the point where it touches a *ſolid Body*.

X. *Whether the ſame Roundneſs is not obſerved in the Drops of Spirit of Wine.*

But the *Drops* of *Spirit of Wine* are never Round; for ſeeing that this *Spirit* is very light, it conſequently abounds with ſo many *Pores*, and its *ſurface* is ſo much interrupted, that but few parts of the *Air* can apply themſelves to it, in order to their compreſſing of it into a Round *figure*, ſeeing that the moſt of them run through it, endeavouring the deſtruction of it. And therefore if this *Liquor* be poured down from on high, it doth not fall down in *Drops* like *water*, eſpecially if it be highly rectified, but is immediately diſſipated in the *Air*, that no ſenſible part of it comes to the Ground: Or, if it be pour'd on a *Table*, cover'd with *Duſt*, it doth not turn into round *Drops*, but ſpreads it ſelf every way, and mingles it ſelf with all the *Bodies* it meets with.

XI. *Whether Water may be made of Air.*

Air is ſometimes condenſed into *water*: Which we ſee in the production of *Fountains*, the Cauſe whereof the *Ancients* very probably aſſign'd to be, the changing of the *Air* into *Water*; which change is facilitated by the reſt or ſtagnation of the *Air* in thoſe parts, and by the *coldneſs* of the *Rocks*. For it is found by Experience, that *Fountains* are moſt commonly generated in ſuch places as theſe.

The Maintainers of this Opinion do very well to add the word, *Probably*, ſeeing there be ſeveral that utterly deny this, and prove the contrary by Experiment. A Modern Perſon, and great ſearcher into the *Nature of things*, took a *Glaſs-Veſſel* with a long Neck, containing a Quart, and ſealed it *Hermetically*; which *Veſſel*, wherein was contained nothing but *Air*, he plac'd in a *Barrel* full of *water*, and left it there the ſpace of 3 years, and never removed it thence all that time, ſave only to obſerve, whether any change had hapned to the *Air*; but he never could perceive the leaſt alteration, or that any part of the *Air* was changed into *Water*; which according to the former Suppoſition ought to have hapned, becauſe of the moiſt and cold *water*, wherewith the *Air* was ſurrounded on every ſide. Which proves them to have been miſtaken, who ſuppoſed that that which was ſufficient to turn *Water* into *Ice*, would alſo turn *Air* into *Water*: Since this change could not be brought about, by means of *cold* and *moiſture*, in the time of 3 years. And the Reaſon of it is plainly this, becauſe the *particles* of the *Air* being very *ſubtil*, are ſo continually agitated by the motion of the *ſubtil matter*, that they always are toſt through one another, and therefore can never be turned into *Water*, no not by means of the moſt intenſe *Cold*.

XII. *Why a Rope being ſprinkled with water becomes ſhorter.*

A *Rope*, or *Cord*, if it be ſprinkled with *water*, ſo that it ſink through it, becomes contracted, and is not ſo long as it was before.

The Reaſon is, becauſe the ſeveral *Threds*, whereof the *Rope* is compoſed, are as it were ſo many *Pipes*, which are blown up by the letting in of *water* into them, and ſo become ſhorter. Hence it is that the *Strings* of a *Lute* break in *moiſt* and *wet weather*, if they be wound up too high: For that the *Threds* of them, turning round like a *Screw* about other greater *Cylinders*, do by this means become contracted, and loſe ſomething of their length.

XIII. *In what ſenſe Water is ſaid to be inſipid.*

All *Water*, but more eſpecially *Rain-water*, is inſipid, and hath either no *taſte* at all, or ſuch as is hardly perceptible.

Tho', to ſpeak exactly, there be no *Bodies* in this *Univerſe* that are altogether inſipid; yet are ſome ſo called, becauſe they are not endued with any eminent or very perceptible *Taſte*; ſuch as are ſome *cold* and *wateriſh Herbs*, the *Raw white* of an *Egg*, and *Common water*; becauſe their *particles* have ſmooth *ſurfaces*, which do not enter the *pores* of the *Tongue*, nor can vellicate or twitch, but only glide over it. Thus *Air* is look'd upon to be inſipid, becauſe it ſwims upon our *Spittle*, and not mingling with it, makes no impreſſion at all upon the *Nerves*. And for the ſame Reaſon it is, that *fat Liquors* do reliſh leſs leſs than others.

XIV. *In Order to the filtring of any Liquor by a ſlip of Cloth, the Cloth muſt firſt be moiſtned.*

Filtration cannot be performed, but with a piece of *Cloth*, that is throughly made wet with *water*: Or, if you will, *Water* will not aſcend by a Label of *Linnen* or *Woollen cloth*, nor run down by that part which reaches down on the outſide of the *Veſſel*, except this part be firſt throughly made wet: For if the propendent part continues dry, the *filtration* can never proceed.

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The Reason is, because in *filtration*, the outward parts of the *water*, wherewith the cloath is wetted, do so insinuate themselves into the *Threds* of it, that they produce there a kind of *thin skin*, through which the inner parts of the *water*, which are in continual agitation, run downwards, and are carried towards that part of the *Cloth* which hangs down without the *Vessel*. Whereas, when any part of the *Cloth* continues dry, and unextended by any *Liquior*, so long this *Pipe* cannot be compleated, which is necessary for the conveying of the *water*; and therefore it is necessary that the whole *Cloth* be moistned. For we must not imagine, that the part of *Cloth* which hangs down without, becomes moistned, because the *water* that is contained in the *Vessel* is driven upwards, for this would be contrary to Nature; but the reason of it is this, because that part of the *filter* being dipt in the *water*, its *Pores* are thereby widened, and so prepared to admit more *water*, which by degrees entring more copiously into the same, doth still more widen the parts, and so continually makes way for the following *Liquor* to ascend.

XV. *Why the water ascends in a Pipe fill'd with Sand.*

After the same manner as *Liquors* mount up by *filters*, so likewise doth *water* ascend in a *Pipe* full of *Sand*, placed perpendicularly in a *Vessel* full of *water*, and whose bottom or lower end, is stopt with such a *Body* through which the *water* can penetrate. For if we leave this *Pipe* thus, the time of 24 hours, we shall find the *water* to be mounted up in the *Pipe* through the *Sand*, about 18 inches high above the *Level* of the *water*, that is in the *Vessel*.

XII. *Why a Rope being sprinkled with water becomes shorter.*

XVI. *Why the water that is at the bottom of Rivers runs more slowly than that which is at the top.*

Those that *Swim* take notice, that the *water* of *Rivers* doth not every where flow alike, and that the stream of the *River* runs more slowly at the bottom, than at the top.

It is not so in all *Rivers*, but only in such whose *bottom* or *channel* is uneven, and hath deep holes in it; for where all the parts of a *Channel* are level, there is no reason why the course of the *River* should be more slow at the bottom than at the top. Conclude we therefore, that this happens in such *Rivers* only when the bottom is interrupted with deep holes, where the *water* is detained longer, than it would be on a *level*, and consequently doth not move so swiftly as the Surface.

XIII. *In what sense Water is said to be insipid.*

XVII. *Why the water only runs down Hill.*

Hence it is evident that *water* always takes its course that way, where it finds a *down-hill*; for seeing that the upper parts of the *water*, do by their *weight* press those that are under them; and that they by reason of their fluidity, except they be kept in on the sides, do spread and slip away; it must needs be that when the *water* is upon a hanging ground, and its lower parts prest by the upper, it must give way and run downwards, to avoid that pressure. For a *down-hill ground*, is more open than a plain or level, for seeing it is nothing else, but a range of perpendiculars the one shorter than the other it, cannot be otherwise, but that the *water* that lies upon a *shelving ground*, upon its being prest must slide down, towards the shorter *perpendicular*. So that it is manifest that no *water* flows upon the *Earth*, but what moves *down-hill*, by reason of the shorter *perpendicular*.

Let a *Glass Vessel* be made, with a *narrow Arm*, and fill'd with *water*: The *water* which is in the *Vessel*, will not be able to thrust the small quantity of *water*, which is in the *Arm* out of its place, nor lift it up higher, tho' it be in much greater quantity, and exceed it in weight.

XVIII. *Water contained in a Vessel of unequal thickness is not driven forwards by a greater bulk of water.*

This effect is to be attributed to the *Heavenly matter*, which is most swiftly carried round the *Earth*, and drives all *Earthly Bodies* towards the *Center* of their *motion*. For seeing that the *water*, which is in the *Vessel*, and that in the *Arm* of it have an equal *Surface*, they are consequently alike pressed downwards by the *Heavenly matter*; and therefore that great quantity of *water* which is in that large *Vessel*, hath no power to push the little *water* that is in the *Arm* out of its place, or to raise it higher.

XIX. *Why a Needle Swims on the top of the water.*

The *Surface* of the *water* is more difficultly divided, than the more inward parts of it: For little *Steel needles*, being laid crossways on the *Surface* of the *water* swim upon it, but as soon as they have divided the top of it, do without stop sink to the bottom.

The Reason is, because tho' the parts of the *water* be uniformly moved, and constitute a smooth and even *Surface*; yet the parts of the *Air*, that surround the *water*, are agitated after a different manner, without any such uniformity in their Motion; by which means it comes to pass, that the *Surfaces* of *Air* and *Water* become smooth and polished; as we see that rough *Bodies* are polished by rubbing against each other. Now it is apparent that *smooth Bodies* are more apt to resist, and exert a greater force in putting by other *Bodies*. And therefore it cannot seem strange, seeing that the *Surface* of *water* is more difficultly divided, than its under parts, that it should support *Steel needles* laid upon it. Yet to this end, the *Needle* must be very slender, and must be laid a thwart upon the *water*, for otherwise the effect would not follow.

XX. *The sharper the Keel of any Ship is the more water it draws.*

From what hath been said may be gathered, why a *Ship* with a sharp *Keel*, doth draw more *water*, and better cuts the *waves*, than that which hath a broader. For a *Ship* pusheth and takes up so much *water*, as its weight is, and all it contains, that so the *water* may be prest equally on all sides. Now the sharper the *Keel* is, with so much the lesser compass it doth beat back and push against the *water*, and doth more easily divide it, than when it is broader; for then it draws but little *water*, and pusheth away a greater quantity of it. And therefore it is, that the Foundations of the *Arches* of a *Bridge* are made sharp pointed towards the *water*, that it may slantingly slide by without exerting its force upon them.

CHAP. III.

Of the wonderful Properties of some sorts of Waters.

I. *Of the cause of hot Waters or Baths.*

SOme *Waters* are *hot* when they break out of the *Ground*; yea there are some *Springs* that are so *hot*, as to boil an *Egg* hard that is put into them.

Some derive this *heat* that is found in *hot Baths* from *Subterraneous Fires*, which lye hid

in the *Bowels* of the *Earth*, and are diffused up and down through it by certain *Channels*, which as the *water* passeth through, it becomes heated. But this doth not seem agreeable to Reason; for whence are these *Subterraneous Fires* fed and maintained, where is their *Fewel*, or how can the same be kindled into a flame under ground? Or how comes it to pass that these *Fires* are not choaked by the smoak that proceeds from them? Or why do not they dilate themselves, and breaking out at the *Surface* devour all before them? It seems therefore more probable, that this *heat* of some *waters* is the effect of a *mixture* of *Liquors*, proper to produce that quality; as we find that *water* poured upon *quick Lime* grows *hot*; and the same effect ariseth from the mixture of *Oyl of Tartar*, with *Oyl of Vitriol*; and *Butter of Antimony*, with *Spirit of Niter*: Which tho' singly they be *cold Liquors*, yet when put together, produce a very intense *heat*; for if *Oyl of Tartar* be poured into *Aquafortis* wherein *Iron* is dissolved, it will not only *work* and *boil*, but break forth into a *Flame*.

Conclude we therefore, that the *heat* of *Baths* proceeds from a mixture of *Jews Lime* and *Brimstone*, which being united together produce *heat* by effervescence.

II. *The heat of Baths, doth not proceed from subterraneous Fires.*

That this is so, may be evidently proved from hence, that the *water* of *hot Baths* being set upon the *Fire*, is as long a *boiling* as any other *cold water*: Neither doth it scortch and burn the *Tongue* as common *water* doth, which hath acquired a like degree of *heat* from our *Culinary Fire*; which shews that the Subject of this *heat* is a thin *Vapour*, which doth not so much penetrate the parts of the *Tongue* and *Mouth*. It is found likewise that this *water*, doth not *boil* and make tender, soft and juicy *Herbs* that are put into it, such as *Sorrel*, *&c.* as soon as common *water*, that hath the same degree of *heat*. The reason whereof seems to be, because the *Volatile Sulphurs*, that produce the *heat* in these *waters*, do so insinuate themselves into the *Pores* of the *Mouth*, or of the *Leaves* of *Sorrel*, that they hinder the *water* from entring into them; or because the *heat* of these *waters* doth wholly consist in these *Sulphurs*, the parts whereof are so *Subtile*, that they cannot exert their force, neither upon the *Mouth*, nor upon the *Leaves* of *Sorrel*; for the very same reason that the flame of *Spirit* of *Wine*, will not burn a *Handkerchief* that hath been dipt in it.

III. *Corrosive Spirits do dissolve Metals, and rather act upon hard than soft Bodies.*

Corrosive Spirits, or *Stygian waters*, as the *Chymists* call them, do penetrate the hardest of *Metals*, and in a short time do dissolve them; but act little or nothing at all upon *Wax* which is soft, but leave it in a manner untoucht. The said *waters* do also more easily dissolve *Iron* and *Steel*, than *Lead*, which is softer than they, and more easily divisible.

The reason is, because these *Corrosive Spirits* do not meddle with those *Bodies* that give way to them, but crumble them to pieces that oppose and resist their entrance. Which will be easily apprehended by those who know that all *Bodies*, do not consist of the same parts, nor have their parts joyned in one and the same manner, but suitable to the variety of their *Bulk* and *Figures*. For as a heap of *Earthen Vessels*, may with a Stick be broken into a Thousand pieces, whereas *Wool* being struck with the same Stick and force, doth admit no change at all; and as *Wool* may be easily cut with the edge of *Knives* and *Scissars*, whereas *Earthen Vessels* cannot; so we may easily understand, how some *Bodies* are easily dissolved by *Corrosive Spirits*, whereas others are scarcely toucht by them.

IV. *A Fountain of Epirus extinguisheth flaming Torches, and kindles those which are extinguisht.*

Historians tell us of a *River* in *Epirus*, producing contrary effects. In DODONA, saith PLINY, *Is a Fountain dedicated to Jupiter, which tho' it be cold and doth extinguish the lighted Torches that are put into it, yet doth it kindle those which are extinguisht when approacht to it.*

This seems at first sight impossible, that *inflammation* should proceed from a *cold* Body as the *water* is: Yet for the clearing of this difficulty we may say, that the *water* of this *Fountain* being *cold*, does extinguish a flaming Torch that is dipt into it, this being the property of *water* to quench and choak *Fire*, and so put a stop to the motion of its agitated parts; but the rekindling of extinguisht *Torches*, cannot be attributed to the *water*, but to the *Bituminous* and *Sulphurous* exhalations, that rise up from the *water*. For it is probable, that this *Fountain* did send forth *Vapours* mixt of *Jews-Lime*, *Brimstone* and *Nitre*, which rising up through the *Fountain* as through a *Chimny*, became inflammable in the open *Air*, especially when a newly extinguisht *Torch* was approacht to them.

V. *The cause of the Interruption of the flowing of the Collismartian Fountain.*

GASSENDUS upon occasion of a *Fountain* mentioned by PLINY, which *Flows* and *Ebbs* thrice a day, mentions the *Collismartian Fountain*, which *Ebbs* and *Flows* 8 times in an *hour*; for the *water* being ready to break forth, discovers it self by a soft *purling noise*, and for about half a *minutes* time *swells* and encreaseth, and the 6 following *minutes decreaseth* again; and when the decrease is ceased, the *water* continues in the same state for a little while, and then begins to flow again. But the intervals between one *Eruption* and another, are not equal, being sometimes more, and at other times less; tho' it very seldom happens, but that in one hour 8 *flowings* or *Eruptions*, and as many Cessations or *Ebbings* may be perceived in an hour.

It is certainly a difficult matter to render a satisfactory reason of this interrupted flowing of the *water*; neither will the instance of the *Fountain* in *Epirus*, be of any great help to us towards the solving of it. For whereas the same abounds with *water* in the *day time*, which fails and ceaseth in the *night*, this may be attributed to the *heat* of the *Sun*, whereby *Fountains* in *Summer-time* are often dried up, and overflow in the *Winter*. But this cant be applied to the *Collismartian Fountain*, which observes its interrupted *Ebbings* and *Flowings* in the *night*, as well as in the *day time*. However, if I may speak my conjecture concerning so abstruse a *Riddle* in *Nature*, I am apt to believe, that within the *Hill* whence this *Spring* breaks forth, there is some *hollow*, or *pit*, which a *Rivulet* continually fills up: As likewise a passage through which some *subterranean steam*, or breeze continually blows, and keeps back the *water*, sending it back to the place opposite to that from whence it came; where it then *swells* and

and encreaſeth, till being overcome by its own weight, it overbears the force of the *Wind*, and ſo runs down, until the *hollow* or *pit* be almoſt exhauſted and remain dry. And after this the *Wind* having recovered its free paſſage again, doth as before withold the *waters* that would run out, and continually drives it back, until by force of the *water* that breaks in, it be driven away again, and give way to it.

VI. *Another like River.* A like *Fountain* to this is mentioned by F. MAIGNAM TOLOSAS in his *Horary Perſpective*, which in *Summer time* doth every *hour* flow from a vaſt, and moſt deep *hollow*, and for a quarter of an *hour* encreaſeth by degrees, with a very great noiſe; and the next quarter becomes a great *River*; the following quarter it ſinks again, and the laſt quarter, lies ſtill, and is in a manner quite dry'd up.

VII. *What is the cauſe of poiſonous or deadly Fountains.* Some *Fountains* are *Poiſonous* and deadly, as was that famous one of *Terracina*, which was called *Neptunes*, in the Country of the *Volſci*, which was the death of all thoſe that drunk of it, and therefore was ſtopt up with *Stones*, by the *Inhabitants*.

This may be occaſioned when the *waters* of ſuch *Springs* run through *Arſenical*, *Mercurial* or *Antimonial Mines*. For as the Fumes of *Arſenick* do kill *living Creatures*, ſo *waters* impregnated with the ſaid *ſteam*, produce the ſame *effect*. Of this kind is the *Lake Aſphaltites*, becauſe of the *Arſenical Jews-Lime* it abounds with; and many other *Fountains* that are found in the Countries about the *Alps*; but as ſoon as they are diſcovered they are filled up and ſtopt with *Stones*, which is the reaſon why ſo few of theſe deadly *Springs* are known.

VIII. *Whether it be true that the Fountain of Jupiter Ammon was cold and hot by turns.* In the Povince of *Cyrene*, as *Hiſtorians* tell us, was a *Fountain of the Sun*, which was hot at Midnight, and afterwards growing luke warm by degrees, was cold at the breaking of day; and as the *Sun* roſe higher, grew ſtill more cold, ſo that at *Noon* it was cold to extremity; and from that time began by little and litle to grow luke warm again, till at the beginning of *night* it was hot, and ſo grew hotter and hotter till *Midnight*.

Some *Philoſophers* have endeavoured to give a reaſon of this change, by aſſerting that there are ſome *Seeds* of *heat* in *water*, which the *Earth*, when chill'd and contracted with the coldneſs of the *night* ſends forth, but when dilated by the *heat* of the *day*, doth take in again. But I fear that in this caſe, we are vainly employed in ſearching for a true cauſe of a meer figment; ſeeing that ARRIAN, CURTIUS, PLINIUS, MELA and other *Hiſtorians* and *Geographers*, who give the deſcription of this *Fountain*, did never ſee it, and had only by report whatſoever they relate concerning it. Every body knows how baſely the *Prieſts* of *Jupiter Ammon* did flatter *Alexander*, when he viſited that *Temple*, and therefore we cannot think ſtrange if they made him believe many things, which they feigned, or by ſome impoſture repreſented to him, to make him conceive a greater veneration for the place and them. And therefore I think it is but reaſonable that we ſhould be fully aſſured of the truth of the thing, before we trouble our ſelves about ſearching out the cauſe of it.

Well water in *Summer* is *cold*, and in the *Winter hot*, or at leaſt ſomewhat luke warm.

IX. *What is the reaſon of the heat that is found in Well water in the Winter ſeaſon.* This *cold* and *heat* doth not proceed ſo much from the *water*, as from our Senſe, which finds the *water* colder in *Summer* than *Winter*. For when we touch any thing with a very *cold Hand*, it appears warm to us; as thoſe things feel *cold*, which we touch with a *hot Hand*. This we experience when we enter into *hot Baths*, which are diſtinguiſht by ſeveral Degrees of *heat*; for when we are enter'd into the firſt *Bath*, we think it *warm*, becauſe our *Body* is yet *cold*, but when we return again from the hotteſt *Baths* to the firſt where we entred, we take that to be *cold* then, and not *hot* as we thought it was at our firſt entrance into it. And the ſame is the caſe of *Grottos* and *Caverns*, which always are of the ſame temperature, but are thought to be *cold*, becauſe in the *Summer* we come into them out of the *hot Air*, in compariſon of which they ſeem *cold* to us: And in the *Winter* ſeem *hot*, becauſe the *External Air* is much *colder*, than thoſe *Grottos* or *Caves* are, with reſpect to which we think them warm. As before hath been ſhewed by the Example of *Oil*.

X. *The ſteam that lies upon the water doth not communicate any heat to it.* We muſt not conceit, as ſome *Peripateticks* do, that the *ſteam* which in the *Winter time* appears upon *Well water*, doth impart any heat to them, becauſe that *ſteam* when felt by the *Hand*, will be found as cold, as the *Air* that ſurrounds it: Whereas the *water* it ſelf will be found to be *hot*; which is a ſufficient proof, that the *water* borrows no *heat* from the *ſteam* that lies upon it. Moreover we find as much *ſteam* lying upon the *ſurface* of *hot Baths*, as upon *Well-water*, and yet no body will ſay, that this *heat* which is in thoſe *hot Baths*, proceeds from the ſaid *ſteam* or *vapor*, ſeeing that it ſcarcely covers the *water*, and diſappears in a Moment. The reaſon therefore why *Well-water* in *Winter* time ſeems to be *hot* to us, is, becauſe we come to it from the *External Air*, which is many Degrees colder.

XI. *Of Springs that make the perſons that Drink of them, Drunk, and others that make the Drinkers to run Mad.* The *water* of ſome *Springs* does inebriate like *Wine* or other ſtrong *Drink*, and this effect is attributed to the *River Lethe*, which being drunk of too freely, does produce the ſame effect as *Wine* does. Others again being drunk cauſe *Madneſs*, or *Dull* ſtupidity.

The cauſe whereof muſt be aſcribed, to the *Jews-lime* wherewith thoſe *waters* do abound. For *Jews-lime*, doth ſtrongly affect the *Brain*, and by obſtructing the *Pores* of the *Nerves*, doth dull and ſtupifie the *Senſes*; much in the ſame manner as the *ſeeds* of *wild Parſneps*, (as AGRICOLA tells us in his 2d *Book of things flowing out of the Earth*) being wrapt in a thin *Linnen*, and put in *Wine* do; as alſo the powder of the *Flowers of Hermodactils*, which being put into *Wine*, do preſently, and ſtrongly inebriate. And thus *Jews-lime* being mixt with *water*, doth inebriate thoſe that *Drink* of it, and makes the Body heavy and lumpiſh.

XII. *A Fountain that makes the Drinkers of it to hate Wine.* We are told of a *Fountain* in *Arcadia*, near the City *Clitor*, and from thence called *Clitorius*, which makes thoſe that *Drink* of it to have an averſion for *Wine*, as *Ovid* aſſures us.

Who with Clitorian Streams his Thirſt allays,
Doth Wine abhor, and water Drinks always.

The

The Reason is, because, as *Wine* doth cause a nauseousness, not only to those that are *drunk*, but also after that they are grown *sober*; so those who drink of those *Fountains*, impregnated with *Jews-Lime*, and having had their Heads clouded and troubled thereby, become affected after the same manner as those who are sick of an *Ague*, and abhor *VVine* and the *smell* of it.

XIII. *Some Diseases are cured by Medicinal Waters.*

Some *VVaters* are endued with a *Medicinal Virtue*, and are made use of by *Physicians* for the curing of several *Diseases*.

The *waters* derive this their *virtue*, from some *Metalline* or *Mineral Matter* which they pass through, as *Brimstone*, *Salt*, *Vitriol*, *Alome*, *Nitre* and *Jews-Lime*. And hence proceeds that great variety which we find in *VVaters*; for *Sulphurous VVaters* do heat and attenuate; *Bituminous* do dull and cloud the *Brain*; *Aluminous* do dry moist and running *Sores*; and *Vitriolick* do astringe. Some of them are immediately conveyed to the *Bladder* and *Urinary passages*, by opening and dilating the *pores* that make way for the said *water* to pass to those parts.

XIV. *Of pretended Miraculous Fountains.*

As to those *Fountains*, of which many *Miraculous Effects* are reported, we may take it for granted, that their highly extolled Virtues are commonly grounded upon the reports of some poor People, who are many times set on by others, for Mony, to tell many Lies concerning the Miraculous Effects they have performed. For whatever some may talk, there is no *Universal Remedy*, or such as is able to cope with, and overcome all *Diseases*. And seeing that great numbers of People do drink, or otherways make use of these *Miraculous Fountains*; those that suppose themselves to have been benefited by them, do extol them; when in the mean time we hear nothing of those to whom they have been of no use at all.

CHAP. IV.

Of Fountains and Rivers.

I. *How Fountains come to spring on the top of Mountains.*

NOthing is more frequent, than to see *Springs* break forth from the *Bowels* of the *Earth*, and mounting upwards, contrary to the natural weight of *Waters*, to make their way through the tops of *Mountains*.

Different Reasons are given by several Men of this Eruption of *Fountains*. Some suppose that the *subterranean waters* do mount upwards through certain *Pipes* or *Channels*, much in the same manner as the *Blood* in the Body of an *Animal* is conveyed through the *Veins* to all the parts of it, to the *Head*, as well as to the *Feet*. This Opinion PLINY seems to favour in his *2d Book, Chap.* 65. *For seeing that the Earth is dry and thirsty, and cannot consist of it self without Moisture; nor the Water neither without the Earths supporting and containing of it; it seems necessary that we admit some Veins, through which the Water may be conveyed, and get up to the tops of the Mountains.* But yet it does not seem probable that the *water* should be this way conveyed in the *Earth*, as *Blood* is in the Body of an *Animal*: For tho' the *water* be driven out of the *Sea* into the *subterranean cavities*, and by this force impress upon it, do continue to mount upwards; yet no sufficient Reason can be given, why the *water*, by that time it is risen as high as the *surface* of the *Sea*, should not stand still there, or fall back again, seeing that the force wherewith it was pusht upwards, now ceaseth.

Whereupon it seems more likely, that the original of *Fountains* ought to be ascribed to *Vapours*, or *particles* of *Water*, separated from each other by the force of *subterraneous heat*. For seeing that under *Plains* and *Mountains* great *Cavities* lie hid, that are filled with *water*, it cannot be questioned but that a great part of them are continually resolved into *Vapours*, and *sublim'd* to the *surface* of the *Earth*, and the tops of the highest *Mountains*; which by succeeding Cold being afterwards turn'd into *water* again, cannot return back the same way by which they mounted, and therefore find out other open passages between the Intervals of the *Crusts* or *Shells* whereof the *Earths surface* doth consist.

II. *Why some Springs flow equally at all times, and others not.*

Some *Fountains* flow continually, and much with the same force, and abundance of *waters*; whereas others are subject to a great decrease in *Summer* and *Autumn*, and some do wholly dry up.

The reason of this decrease in some *Springs* is, because the *pores* of the *Earth* are very open during those *Seasons* of the *Year*, by reason of the *Heat* that dilates them; and by this means furnish the *Vapours* a ready and open way to fly away, and mingle with the *Air*, and therefore can no more supply the *Spring* with *water*, as they did whilst they continued shut up within the *Earth*. And it sometimes happens, that this *Evaporation* is so great, as to dry up the *Spring* altogether. But as to those *Springs*, that flow continually, and much with an equal force, the reason of their perpetuity is, because the Channels by which their *waters* are conveyed, are so deeply lodged in the *Earth*, the *Summers Heat* cannot reach them to dilate their *Pores*: which is the reason why the *Vapours*, being always furnish'd in the same quantity, must also produce an equal and continual *springing*, or *flowing* of the *water*.

III. *How Fountains of Oyl are generated.*

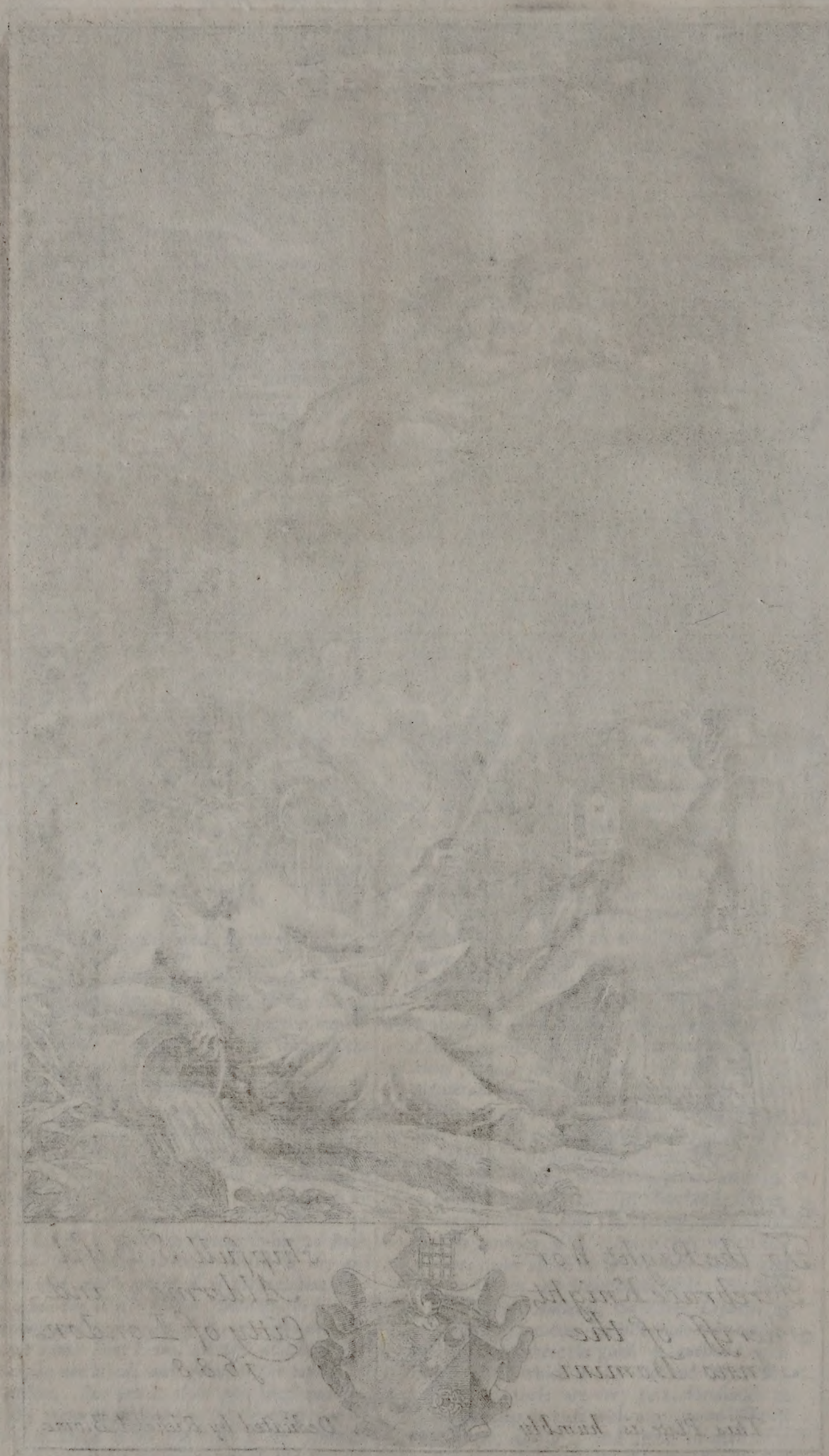
Hence it is also, that in some hollow parts of the *Earth*, *Oyl* breaks forth instead of *water*, *viz.* when the *Heat*, that is in the *Bowels* of the *Earth*, is of force enough to lift up thick and gross *Exhalations*; which meeting with the *cold* parts of the *Mountain*, become thereby condensed, and joining together, constitute a thick *Liquor*, very like *Oyl*. Thus we are told of a *Valley* in *Alsatia*, called *Leberthal*, from whence there breaks forth a fat and thick *Liquor*, which *Waggoners* make use of to grease their *Wheels*. In *Scotland* also, 2 miles from *Edinburg*, there is a *Spring*, the *surface* whereof is covered with a *Black Oyl*, which the *Inhabitants* make use of to soften their *Skins*, and to heal the Chops and Roughness of it. So likewise amongst the *Antients*, the River *Liparis*, in *Cilicia*, was very famous, because those that bathed themselves in it, were as good as *anointed* with the *water* of it, which was so soft and *Oily*. But such *Springs* as these are very rare, forasmuch as thick *exhalations* do arise with much more difficulty than *watry vapours*, and stand in need of a great degree of *heat* to raise them to the *surface* of the *Earth*.

Spring-

C. Fremin. Inv. I. Kip. Sculp.

To the Right Wor= shipfull S.r Basil
Firebrace Knight, Alderman and
Sheriff of the Citty of London
Anno Domini 1688.

This Plate is humbly Dedicated by Richard Blome.



IV. *Why Spring Water is fresh.*

Spring-water is generally fresh, without retaining ought of the *saltness* of the *Sea*, whence it is derived.

The Reason is, because the *fresh particles* of the *Sea-water* are most proper for *sublimation*, as being both thin and limber; whereas the *saline particles*, being stiff and hard, cannot be changed into *vapours*, nor pass through the crooked and winding *pores* of the *Earth*. *Fountains* therefore are fresh, because they consist only of those parts of the *water* that have been strained through the narrow *pores* and windings of the *Earth*, or that have been sublimed into *Vapours* by the force of *Heat*.

V. *The Original of Salt Fountains.*

There are some *Salt Fountains* in *France*, as near *Caen* and *Bordeaux*, besides several here in *England*; and a great many almost every where upon the Coast of *Africa*; in the *East Indies*, near *Cormandel*, almost all the *Wells* are *Salt*. So likewise in the *Island* of St. *Vincent*, many of these *Salt Springs* are found: and on the Shoars of *Peru*, several *Salt Lakes*. Besides all these *waters* which had their original, either from an inundation of the *Sea*, or by some inlet from the *Sea*; such is that *Lake* in *Holland*, commonly called *Haerlem-Meer*. There is also a *Salt Lake* in the *Island* of *Madagascar*, and in that of *Cuba*, which is 2 Leagues in compass, and is not far distant from the *Sea*. Now the cause of these *Springs* and *Lakes* is, because the passages of the *Earth*, through which their *water* is conveyed, are very large and open, so that very few or none of their *Saline Particles* can be strained from them; or else because their *waters* pass through some *Saline Veins*, and so become impregnated with *Salt*.

VI. *Why some Springs abound with water in the* Winter, *and in* Summer *are dried up.*

Some *Springs* run copiously all the *Winter* long, but during the heats of *Summer*, their *waters* fail and run no longer.

Such *Fountains* as these, owe their Rise to *Rain* and *Snow*, which supply them with their current. For there are many great *Caverns* under the *Earth*, and especially under high *Hills* and *Mountains*; which being fill'd with *Rain* and *Snow-water*, do, according to their largeness, in a longer or shorter time, exonerate themselves. And thus we find, that after long and contiued *Rains*, new *Springs* are seen to break forth; which upon great and long continued *Heat* and *Drought*, are dried up again, until the said *Caverns* be supplied again, and filled by frequent *Showers*, or the melting of *Snow*, and so begin to run as before. Thus we read, that in the time of *Elias* the *Prophet*, the *Springs* were all dryed up; for the *Doors* of *Heaven* being shut up, neither *Rain* nor *Snow* fell down upon the *Earth*, to supply the continual expence of the said *Springs*.

VII. *Why Rivers cannot run but on a shelving ground.*

All *Rivers* have their Current from a *shelving ground*, and where they lie upon a perfect level, they continue unmoveable.

The Reason is, as before hath been hinted, because those parts of the *water* that are uppermost, do by their weight press those that lie under them; which being fluid, and readily giving way, slide downwards, where they have more room to spread themselves, and are not so much straitned. For a shelving ground, or down-hill, is, as it were a continued Range of *Perpendicular Lines*, in which the *water* cannot be pressed, but it must fall upon the bottom of the shorter perpendicular. For if the *Channel*, along which the *Rivers* run, were not shelving, no reason could be assigned, why they should run this way, more than that way; more towards the *East*, than towards the *West*. Moreover, the *Sea*, when it swells with the *Tide*, would be of an equal *altitude* in the Rivers, in case they did run along an *Horizontal Plain*, and not along a shelving ground.

VIII. *From the Course of Rivers, we know the Altitude of Places.*

Thus from the *Springs* and *Current* of *Rivers*, we know that some parts of the *Earth* are *lower* than others. Forasmuch as that part of the *Earth*, to which the *water flows*, is lower than from whence it *flows*. Hence it is that we know *Bohemia* to be higher than *Holstein*, from the Current of the *Elbe*. And thus likewise from the *Danube*, *Visurgis*, the *Rhine*, the *Maes*, *&c.* we take our *Judgment* of the *Altitude* of the several places through which the said *Rivers* pass. Thus *Switzerland* and the Country of the *Grizons*, are counted by some to be the highest ground of *Europe*, because the *Rhine*, the *Rhone* and the *Danube* proceed from them. Now as great as is the *Down-hill* of these *Rivers*, so great is the altitude of the *Mediterranean* places, above those on the *Sea-coasts*.

IX. *What is the reason of the swift current of Rivers.*

And the greater the Down-hill or Declivity of the *Channels* of *Rivers* is, the swifter is their *Current*; and the less it is, the slower is their Course. And the same thing is the reason, why one and the same *River*, runs more swiftly in one part of its Course than in another, which is observable in many places of the River *Rhine*. For if the bottom of a *River*, within the compass of 200 paces, lean down one pace, the *water* runs so swiftly, that it cannot be navigated without danger. In those places therefore where there are *Cataracts*, or Downfulls of Water, there the *Rivers* run with the greatest swiftness. And therefore it is that *Brooks* run with that violence, because they are precipitated from the tops of *Mountains*.

X. *Whether the Course of Rivers be always towards the* West.

All great *Rivers* flow towards the *West*, and none of them towards the *East*.

This hath been generally believed, but without sufficient ground; seeing it is evident, that the *Rhine*, the *Nile* and *Ob* flow towards the *North*; the *Rhone*, and the River *Indus*, towards the *South*; the *Danube*, the River of the *Amazons*, and that of St. *Laurence*, towards the *East*. Whence we conclude, that *Rivers* do not tend to one particular part of the *World*, but are indifferently carried to any part of it.

XI. *How it comes to pass that fresh water sometimes springs in the midst of the Sea.*

It is sometimes found that *fresh water* springs in the *Sea*, tho' not far from the Shoar. Yea, some *Historians* assure us, that in the Province of *Jucatan*, in *America*, a vein of *fresh water* springs a cubit high, above the surface of the *Sea*.

The reason whereof is, because the *Receptacles* of *water* that are in the neighbouring *Mountains*, have their *vents* or out-lets so disposed, as not to tend upwards towards the top of those *Mountains*, but downwards: So that the *waters* flowing out from them, do meet together with a large *Channel*, where they constitute a *Spring* or *Fountain*; and therefore must needs break forth in some low place, that is, from the bottom of the *Sea*; and because their eruption is forcible, they *spring* sometime above the *surface* of the *Sea-water*. The reason why some *Rivers*, running into the *Sea*, do for a great way retain their freshness is, because

their *Current* is so swift and violent, that they push back the *Sea-water*, and keep it from mingling with them, till at last, by a longer process, their force being weakned, they mingle with the *Salt-water*, and are lost in it.

XII. *The Cause of the constant Inundation of the River Nile, after the Summer Solstice.*

The River *Nile*, which is but 18 *foot deep*, doth sometimes swell to the height of 18 *Cubits*, that is, 27 *foot*, and at other times to 12 *Cubits*: And this Inundation is so constant, that it always happens at a set time, that is, presently after the *Summer Solstice*.

The Common Opinion of the *Antients* was, that this swelling of the *Nile* was caused by the *anniversary winds*, called *Etesiæ*, which did blow about that time; and driving against the *mouths* of this River, did stop the vent of its *waters* into the *Sea*, and by consequence made its Channel to swell, and run over its *Banks*; according to the account the Poet *Lucretius* gives us of this Inundation, in his 6*th* Books.

In Summer Nile *o're-flows, his Streams do drown*
The Fruitful Egypts *Fields, and his alone;*
Because the Mouth of that wide River lies
Oppos'd to North, *from whence th'*Etesia's *rise*
From heavy Northern *Clouds, and fiercely blow*
Against the Streams; *these stop, and rise, and flow.*

But this doth not seem to be the genuine cause of the *overflowing* of *Nile*; since it is certain, that the *Nile* sometimes *overflows*, before that these soft *winds* begin to blow, and consequently before they can stop the *Mouths* of it, in order to cause the said *Inundation*. And that this overflowing ceaseth, before they cease to blow, and to drive its *waters* upwards, as is supposed. Wherefore the cause of this *Inundation* may, with more ground be ascribed to the great and frequent *Rains* that fall in *Ethiopia*, from about the middle of *June*, till *September*; because the time of their *Winter* is from the end of *May*, to the beginning of *September*. And in like manner, the River *Paraguay*, or as the *Spaniards* call it, *Rio de la Plata* doth overflow, at the time when great *Rains* fall on the Mountains of *Peru*, which obligeth the *Inhabitants* for 3 Months to live in *Boats*.

XIII. *What is the reason of the sudden rising and vanishing of some Fountains.*

It is observed, that *Fountains* do sometimes, all on a suddain, break forth on the *Mountains*, which were never seen before; and that others on the contrary, do as suddainly vanish and disappear.

This sometimes is caused by *Earthquakes*, whereby the hidden Sources of *Springs* are broken up, and the obstacles that retain'd and kept them from breaking forth, are removed. And they dry up, and suddainly disappear, when some new obstacles are cast up to stop their way; or when the *water* is sunk down into such deep *Caverns*, from whence it can no more be elevated: For in this case it is forced to change its course, and turn aside another way. Who does not know that a vast heap of *waters* is hid in the hollows of *Mountains*, which being opened by an *Earthquake*, way is made for the said *waters* to break forth?

XIV. *Why some Rivers run under Ground.*

Some *Rivers*, in the midst of their Course, run and hide themselves under *ground*, and afterwards start up again like new *Rivers*. Thus the River *Niger*, in *Africa*, which some suppose to be derived from the *Nile*, by a *subterraneous passage*, by that time it meets with the *Mountains* of *Nubia*, runs down under ground, and breaks out again on the *West* side of the said *Mountains*.

The Reason of this is twofold. 1*st*. The obstacle of a higher ground than is the bottom of the *River*. 2*dly*. The Hollow that is under the *ground*, at the place where the *River* hides it self, or the looseness of the *ground*, which easily gives way to the force of the *River*. Thus the River *Tigris*, in *Mesopotamia*, after it hath passed the River *Arethusa*, meeting with the Mountain *Taurus*, runs down into a *Cave*, and ariseth again on the other side of the *Mountain*; and afterwards having passed the Lake *Thespis*, hides it self again under ground, and riseth up again about 6 *German* miles farther.

CHAP. V.

Of the Sea.

I. *Why the Sea seems to be higher than the Earth.*

THE great Mass of the *Waters* of the *Sea*, appears higher than the *Earth*, and seems to be raised much above the *surface* of it. And therefore to those who take a prospect of the *Sea*, from the *Shoar*, the *Sea* seems higher than the *Land*; and when from the *Sea*, they look to the Shoar, that appears lower than the *Sea*.

Some persons, measuring all things by their *Eye-sight*, suppose the *Sea*, because of the same *convexity* it hath with the *Earth*, to rise by degrees above the *Earth*; and that it is not only higher than the *ground* or bottom of the *Earth* that supports it, but is also higher than the *Islands* and *Continents*. But this is no better than a *deception of the sight*, which reaching forwards towards the more remote *parts* of the *Sea*, is directed towards them by *Rays*, which the more they recede from a Perpendicular, the further distant and higher it represents them. This we find by experience, not only in the *Sea*, but in any great *Plain*. And on the other hand, the reason why the *Shoar*, beheld from the *Sea*, appears lower than it, is because the height thereof is contained in the least *Visory Angle*, which the Roling Waves do intercept, and take away the sight of; so that it is no wonder if the *Shoar* seems to be more depress't than the *Waters*.

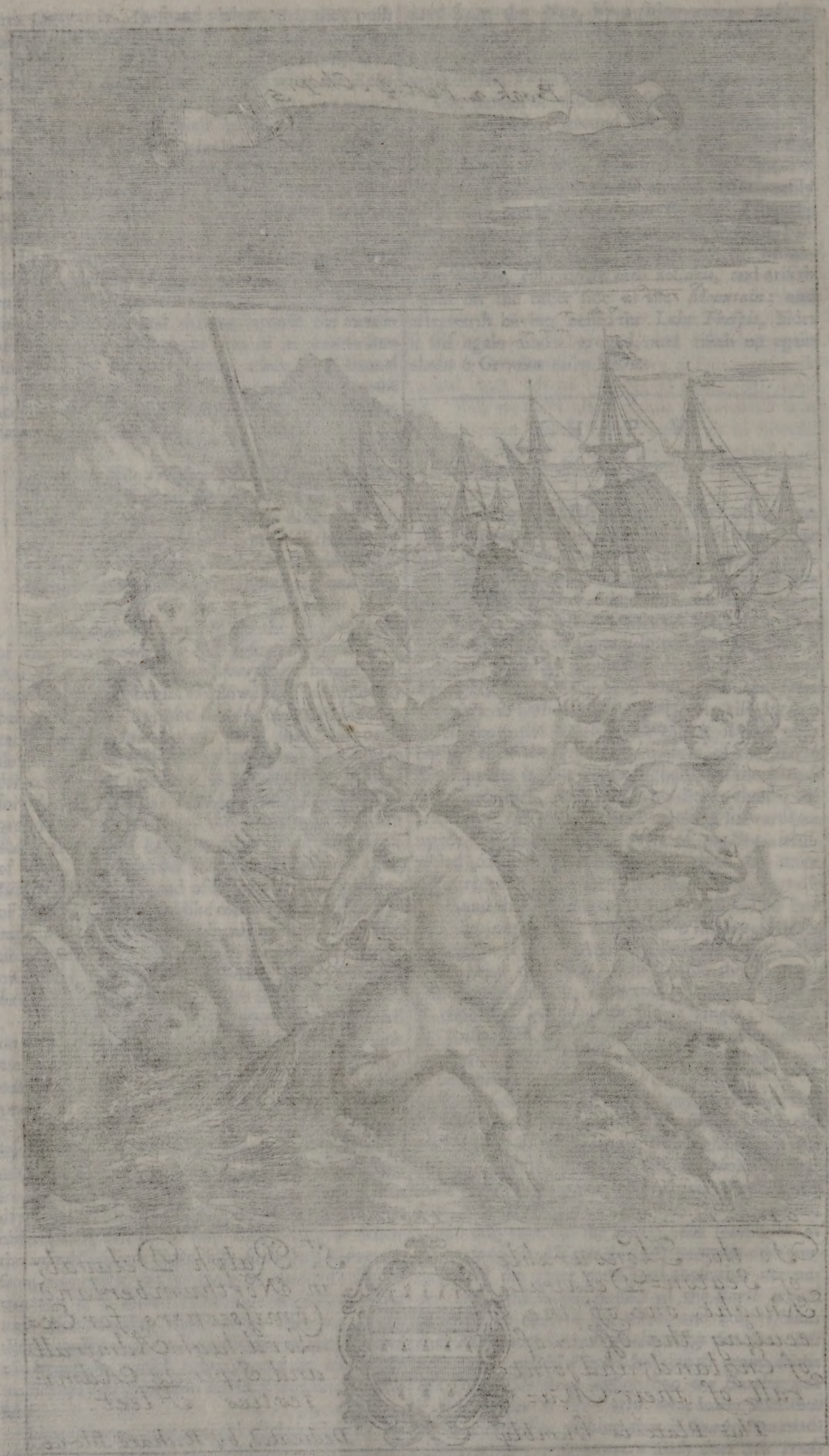
II. *That the Water is not higher than the Earth, proved.*

But besides this, we have a very convincing Argument to prove, that the *Sea*, setting aside the swelling of its *Waves*, is not higher than the *Earth*. For this supposed, it must follow, that the *Water*, by its natural *gravity*, would overflow, and quitting the upper part of the *Earth*, would only take up the lower. Or forasmuch as the parts of the *Water* do push forwards one another, and the upper parts press those that are under them, the whole *surface* of the *Earth* would presently be covered by them, and both *Islands* and *Mountains* be overwhelmed by the *Sea*. Besides, how would *Rivers* be able to return to the *Sea*, if the *Sea* were higher than the *Earth*; and if the *surface* of the *Earth* were lower than that of the *Sea*? For nothing that is *heavy* does naturally tend upwards, as every *Body* does that *tends* to a *Body*, that lies higher than it self.

And

To the Honourable Sr. Ralph Delaval, of Seaton-Delaval in Northumberland Knight, one of the Comissioners for Executing the Office of Lord high Admirall of England; and joint and Seperate Admirall of their Majesties Fleet.

This Plate is humbly Dedicated, by Richard Blome.



III. The Red-Sea is not higher than the Mediterranean.

IV. Scaliger's Mistake about the height of the Sea.

V. Why a ship cannot without difficulty be brought out of the Haven into the Sea.

VI. How it comes to pass that the Rivers return to the Sea.

III. *The Red-Sea is not higher than the Mediterranean.*

And therefore it was a vain Fear into which the *Mathematicians* caſt the Kings of *Egypt*, when they diſſuaded them from cutting a *Channel* from the *Red-Sea* into the *Nile*, or the *Mediterranean*; ſuppoſing the *Red-Sea* to be 3 Cubits higher than the *Mediterranean*, and that therefore a *Deluge* would be the conſequent of that Enterprize. For indeed, had the *Red-Sea* been only one Fingers-breadth higher than that part of the *Mediterranean* which waſheth the Shoars of *Egypt*, the whole compaſs of *Africa*, would not hinder it from running thither, till both *Seas* were reduc'd to a Level. Thus, becauſe th *Caſpian Sea* is higher than the *Euxine*, therefore it empties it ſelf into it: And becauſe the *Euxine-Sea* is higher than the *Ægean* or *Archipelago*, therefore it falls down into it.

IV. *Ariſtotle's Miſtake about the height of the Sea.*

This diſcovers ARISTOTLE's Error, who aſſerts the *Ocean* and the *Earth*, to be higher toward the *North*, than about the *Æquator*; becauſe the *Ocean* ſeems to flow from the North parts of the *World*, as from its Head or *Fountain*. But indeed, nothing of certainty can be thence infer'd: For it is doubtful as yet, and hath never been ſufficiently proved, neither from that *motion* can it ſufficiently be cleared, whether the *Northern Countries*, and more particularly the *Channels* of *Northern Rivers*, be higher or lower than the *Channels* of thoſe that are about the *Æquator*. The Reaſon is, becauſe this *motion* is not General or Univerſal, as not being found in all *Northern Countries*. And tho' we ſhould grant this *motion* of the *Ocean* from the *North*, yet doth it not follow from thence, that the *Ocean* there is *higher*, becauſe it is to avoid this greater height, that the *Sea* flows from the *North* towards the *Æquator*.

V. *Why a Ship cannot without difficulty be brought out of the Haven into the Sea.*

But ſome Body may Object: If it be ſo that the *Sea* is not higher than the *ſurface* of the *Earth*, how comes it to paſs, that it is more hard to get *Ships* out of the *Haven* into the *Sea*; than it is to enter into it from the *Sea*?

I Anſwer, That the Reaſon of this is, not becauſe the *Sea* is higher than the *Earth*; but becauſe when a *Ship* is getting out of the *Haven*, it hath but little *Wind*, becauſe the *Shoars* and *Banks* break the force of it, and hinder it from ruſhing with a full ſwing againſt the *Sails*. Whereas, when a *Ship* enters the *Haven*, nothing hinders the *Wind* from coming with full force againſt them.

VI. *How it comes to paſs that the Rivers return to the Sea.*

Rivers continually exonerate themſelves into the *Sea*, and having paſt through ſeveral Tracts of the *Earth*, return to it again; and yet the *Sea* is never increaſed by this acceſſion of the *Water* of innumerable *Rivers*, that continually, without ceaſing, run into it.

The Cauſe hereof is, that continual Change, whereby the *Sea-water* is turned into *Vapours*, and they again changed into *water*. For as we ſee in an *Animal*, that the *Blood* runs out of the *Hollow Vein* into the *Heart*, and preſently after is from thence diſperſed through the *Great Artery*, to all the parts of the *Body*: So the *Vapours* ariſing from the *Sea*, are conveighed through the Paſſages of the *Earth*, to the tops of *Mountains*, and there being condenſed by the Coldneſs of the place into *water*, become *Springs*, and afterwards *Rivers*; which through the ſlanting places of the *ſurface* the *Earth*, are carried again towards the *Sea*, which is the place from whence they firſt proceeded: So that as much *water* as is thus evaporated from out of the *Bowels* and *Caverns* of the *Earth*, ſo much flows into them again from the *Sea*; and as much as runs from the *Sea* through theſe *ſubterranean Paſſages*, ſo much the *Rivers* return to the *Sea* again.

VII. *Why the Sea always preſerves the ſame degree of ſaltneſs.*

Neither is it any matter of wonder, that the *Water* of the *Sea* continues *ſalt*, notwithſtanding ſhe receives the *Freſh-water* of ſo many *Rivers* into her Boſom: And ſo much *Salt-water* continually flows from her into the Bowels of the *Earth*, and which leaves its *Salt* in the places where they are diſtill'd into *Vapours*. For beſides that the *Sea-water* may be conveighed into the *Earth* to thoſe places where it is thus diſtill'd, by ſuch large and open Paſſages, that the *water* which is left after the *Evaporation*, may carry back all the *Salt* which it could not elevate, into the *Sea*; the *water* which runs continually through the *Mines* of *Salt*, do carry along with them at leaſt as much of it to the *Sea*, as the *Sea-water* conveighs into the *Bowels* of the *Earth*: Whence it is evident, that the *Sea* muſt always keep its *ſaltneſs*, as we ſee it doth.

VIII. *Why the Sea is found to be more ſalt in the heat of Summer.*

In the *Heat* of *Summer* the *Sea* is found by Experience to be *Salter*, than at other times: Which they who live under the *Æquator* and *Torrid Zone* are very ſenſible of.

The Reaſon is, becauſe the *Sun*, which is extream *hot* in thoſe parts, doth evaporate the thinner and freſher parts of the *Sea*, leaving the more thick and groſs parts behind. And the more vehement this *heat* of the *Sun* is, the more are the outward parts of the *Water* agitated, and a greater abundance of *Vapours* are ſublim'd; which being condenſed in the *Air*, and reduced again to *water*, do not always fall down in the ſame place from whence they proceeded; but frequently having taken a large turn in the *Air*, fall down to the *Earth*, at a great diſtance from the place of their firſt elevation. An Example whereof we have in *Salt-water* that is boyled over the *Fire*, which the longer it is boyl'd, the *ſalter* it grows; becauſe the freſh *particles* are continually exhaled from it.

IX. *How it may be prov'd, that our Spittle is ſalt.*

Hence it is that our Modern *Phyſicians* ſuppoſe our *Spittle* to be *ſalt* and *ſowriſh*; for when we *ſpit* upon a *hot Brick* or *Iron*, it leaves a white Spot behind it, which is nothing elſe but a collection of *ſaline particles*, that becauſe of their Stiffneſs and Heavineſs, could not fly away together with the *watry particles*.

X. *Why the Sea is more ſalt betwixt the Tropicks, than elſewhere.*

The Reaſon why the *Sea* is more *ſalt* betwixt the *Tropicks* is, becauſe the *Sun* diſpenſeth more *heat* towards the *Æquinoctial Line*, than in places at a farther diſtance from it, and conſequently reſolves more of the *Particles* of *freſh water* into *Vapours*, and by the extraction of them leaves the *Sea-water* ſalter than it was before. To which may be added, that the *Sea* is of a far greater extent between the *Tropicks*, than in the *Frigid* and *Temperate Zones*, and leſs *Rivers* empty themſelves into it.

XI. *Why Sea-water near the Æquator is more proper for Salt, than others.*

And from hence we may eaſily perceive the Reaſon, why the *water* of the *German Ocean*, and of other parts of the *Northern Sea*, is not ſo good to be boiled into *Salt*, as is the *water* of the *Spaniſh*

Spaniſh Sea, the *Canary Iſlands*, and *Cape Verd*, or the *Green Promontory* in *Africa*; *viz.* becauſe theſe laſt parts of the *Sea* are nearer to the *Torrid Zone*, and receive its *waters* from the *Ocean* of that Place. But yet it cannot be deny'd, but that ſome of theſe *Seas* are more proper for the making of *Salt*, than others. Thus the *Sea-water* that is upon the Coaſt of *Guinea*, in the *Æthiopick Ocean*, doth at one boyling afford a *Salt* as white as *Sugar*, ſuch as neither the *Spaniſh-Sea*, nor the *Sea-water* of any part of *Europe* can afford at the firſt *boyling*.

XII. *How Sea-water may be made freſh.*

Dig a *Pit* on the Sea-ſhoar, a little higher than the Tide reacheth, and as deep as the loweſt Sea-mark; and when the *Tide* comes in, you'l find it fill'd with *Freſh-water*. This is an Experiment commonly try'd by the *Inhabitants* of the Sea-Coaſt of *Barbary*, who have little other *Freſh-water*, but what they get after this manner.

The Reaſon of this Experiment is, becauſe the *Sea-water* loſeth its *ſaltneſs* by ſtraining through the *Sand*, between which it leaves its Corner'd parts, which are the cauſe of its *ſaltneſs*. But yet it is not neceſſary, in order to the ridding of *Sea-water* from its *ſaltneſs*, that the *pores* through which it is ſtrained, be extream ſtrait and narrow; for if they were ſo, they would preſently be ſtopt up, by the firſt *ſaline Particles* that entred them, and ſo there would be no way left for the *particles* of the *Freſh-water* to paſs. But it is rather neceſſary, that the *Sea-water* be ſtrained through thoſe *Bodies*, whoſe *pores* are large enough, and full of Corners and Windings, proper to ſtop the *particles* of *Salt* from running along with the *Freſh-water*. It is alſo neceſſary, that the *Body* through which it is ſtrained be large enough, that ſo, ſince it can rid it ſelf of the *Salt* all at once, it may have a ſufficient ſpace to drain through, to rid it ſelf thereof by degrees, by paſſing through the ſeveral Crooked windings of it; and therefore ſome time is required, before the *Sea-water* can paſs through that ſpace, which is neceſſary by filtration to ſeparate its *Salt* from it.

XIII. *Why the Sea-water is ſalt.*

Reaſons may alſo be aſſigned, why it pleaſed the *Creator* of all Things that the *Sea* ſhould be *ſalt*; *viz.* 1*ſt*, That it might not be apt to putrifie, corrupt and ſtink. 2*dly*, That the *Sea-water* might not be ſo eaſily reſolved into *Vapours*, as the *Freſh* is, by reaſon of the Heavineſs the *Salt* imparts to it. 3*dly*, That the *fleſh* or *ſubſtance* of the *Fiſhes*, that breed and live in it, might be the firmer. 4*thly*, That it might be the more able to reſiſt the violence of *Winds* and *Storms*. For *Salt-water* is more firm and conſiſtent, than *Freſh*. 5*thly*, That it might be the better able to reſiſt *cold*, and not be ſo eaſily *frozen*, as *Freſh*.

XIV. *Why the Water of the Sea runs Weſtward.*

Conſtant and known Experience hath informed *Sea-men*, that the *Sea* moves from Eaſt to Weſt: So that by this means *Ships* have a ſhorter or more ſpeedy Navigation to the *Weſt-Indies*, than to the *Eaſt*. And all *Navigations* to the *Eaſt*, are found more difficult, and take up more time.

This proceeds from the Inequality of the *parts*, whereof the *Earth* and *Water* do conſiſt. For tho' this *Terraqueous Globe*, by its Diurnal motion, moves from *Weſt* to *Eaſt*, about its own *Center*; yet becauſe the *Earth* is more ſolid and heavy than the *Water*, therefore it is whirl'd about its *Center* more ſwiftly, than the *water*: So that the *water*, which is more ſlowly carried about, ſeems to move towards the *Weſt*; in like manner as a *Boat*, that moves more ſlowly towards the ſame place, appears to tend the quite contrary way to another *Boat* that moves more ſwiftly.

XV. *This motion is only perceptible between the Tropicks.*

This *motion* of the *Sea-water* from Eaſt to Weſt, is moſt perceived between the *Tropicks*, and in the *Torrid Zone*; becauſe tho' the *Earth* be *Spherical*, yet becauſe that part of its Roundneſs which is between the *Tropicks*, is whirl'd about with the greateſt force towards the *Eaſt*, as being furtheſt from the *Poles*; whereas that part which is without them, becauſe of its nearneſs to the *Poles*, is moved more ſlowly, therefore it is that this *motion* is only perceptible between the *Tropicks*.

XVI. *Of Currents obſerved in the Sea.*

Beſides the General *motion* of the *Sea*, which belongs to the whole Maſs or *Body* of it, there are alſo ſeveral particular *motions* obſerved in it, which are called *Currents*; whereof ſome happen *conſtantly* at certain Seaſons of the year, but others are not ſubject to any fixt time. They that Sail to the *Eaſt-Indies*, obſerve ſome very ſwift *Currents* in their way thither: For tho' the *Tide*, in thoſe *Seas*, do not riſe above 2 or 3 Foot; yet they extend themſelves the ſpace of 12 or 13 Hours towards the *North*, and the reſt towards the *South*, with ſuch an extream Violence, that it ſometimes breaks the ſtrongeſt *Cables* of *Ships* lying at *Anker*.

XVII. *The Cauſe of certain and fixed Currents.*

There be 2 ſorts of theſe *Currents*, the one conſtant and fixt, the other inconſtant and irregular. It ſeems probable, that the conſtant *Currents* that are obſerved between the *Tropicks*, do proceed from hence, becauſe the *waters* that run Weſtward, are more ſtraitned in ſome places, than in others; either becauſe the *Bottom* of the *Sea* is more deep there, or becauſe of a range of *Rocks* in *Parallel Lines*, which oblige them to follow their direction. And as to thoſe *Currents* that are found without the *Tropicks*, and which continue always the ſame, it is very likely that they proceed from ſome *Rivers*, which continually diſcharge themſelves into the *Sea*. For as there are ſome *Rivers* which appear above the *Earth*; ſo there are others alſo that lye hid, and which flow beneath the *ſurface* of it.

XVIII. *The Cauſe of inconſtant and irregular Currents.*

As to thoſe *Currents* which are Incertain and Irregular, both as to the *time*, and the determination of their *motion*, they ſeem to be cauſed by the Unevenneſs of the Bottom of the *Sea*, by reaſon of divers *Rocks* ranged in Lines, differently tending towards the 4 Principal parts of the *Horizon*. For this ſuppoſed, whenever there is a ſtiff Gale of *Wind*, it muſt needs drive the *water* forceably between theſe *Rocks*, and by ſo doing muſt force them to take a Courſe by ſo much the more violent, as the *Wind* is ſtronger, and the ſpace betwixt the *Rocks* ſtraiter.

XIX. *The Sea-water can bear more heavy burthens, than the Freſh-water.*

The *Sea-water* doth more powerfully reſiſt the *Bodies* that are put into it, than *River-water*: As we ſee that ſometimes thoſe *Ships* which were born up by the *Sea*, do ſink in the *River* or *Haven*.

The Reaſon is, becauſe the *water* of the *Sea* is more *heavy*, as conſiſting of more thick and ſolid Parts, and which may lye in a leſs room, and therefore are more able to bear the *burthens* put upon

upon them. This is moſt evident in the *Dead-Sea*, which becauſe of its extream *ſaltneſs*, will buoy up a Man, that is caſt into it with his Hands and Feet bound. HIERONYMUS FLORENTINUS relates, that he ſaw a Man that was caſt headlong, bound *Hands* and *Feet*, into the *water*, yet was kept up by it for a whole Night: And POSSIDONIUS affirms, that he ſaw in *Spain*, Tiles made of an *Earth* wherewith they ſcour *Plate*, ſwimming on the top of the *water*. Neither can any other Reaſon be given, why a *Ship* draws more *water* when ſhe Rides in an *Haven*, than at *Sea*; but becauſe the *water* in the *Haven* is not ſo *ſalt* as the *Sea-water*, and therefore doth not buoy up the *Veſſel* ſo ſtrongly, as the more *Salt-water* of the *Sea*.

XX. *Why Wine through a Flannen or Linnen-Bag, of a Conical figure, loſeth its ſtrength.*

This alſo is the Reaſon why *Wine* that is ſtrained through a *Flannen-Bag*, commonly called *Hippocrates his Sleeve*, doth loſe the greateſt part of its ſtrength; becauſe many of thoſe *particles*, wherein the ſtrength of the *Wine* doth conſiſt, do continue ſticking in the *pores* of the *Filter*, by which means the *Wine* being deprived of them, proves much more weak than it was before.

XXI. *Salt-water is not proper to quench Fire, but rather increaſeth it.*

Salt-water is not good to quench *Fire* with, for it rather promotes it.

The Reaſon is, becauſe the *particles* of *Salt*, which predominate in *Salt-water*, being *ſtiff* and *inflexible*, are eaſily agitated by the *Bodies* they meet with; and being thus agitated, are very proper to increaſe the *Flame*, ſeeing that of themſelves they oft produce a *flame*, when at any time they break forth violently from the *Bodies* in which they are contained. To this may be added, that the *Sea-water* is much thicker and fatter, than *Freſh-water*, and ſo is more proper to feed and foment the *flame*, than to extinguiſh it. It was by this means that the *Fire-works* caſt into MARK ANTONY's *Fleet*, in the *Sea-fight* at *Actium*, did much greater Execution, becauſe the *Souldiers* not underſtanding the Nature of *Sea-water*, endeavouring to quench the *Fire* kindled in their *Veſſels*, by pouring *Sea-water* upon the *flame*, did thereby ſtrengthen and increaſe it.

XXII. *When Fire hath got the Maſtery, it is rather increaſed by pouring a little Water upon it.*

Yea, it may be obſerved, that tho' *Water* be very contrary to *Fire*; yet there be ſome *Bodies*, which after they have *water* caſt upon them, do flame ſo much the more. And therefore it is that *Smiths* ſprinkle *water* upon their *Sea-Coal*, to make them burn the more violently. And nothing is more evident, than that a ſmall quantity of *water* caſt upon a ſtrong *flame*, doth but augment it. But *Salt-water* doth this with greater efficacy, becauſe of the ſtiffneſs of the parts of it, which darting into the *flame* like ſo many little *Arrows*, and hitting againſt other *Bodies*, have a great force to ſhake and agitate them: Which is the Reaſon why *Salts* are made uſe of for the melting and ſolution of *Metals*.

CHAP. VI.

Of the Ebbing and Flowing of the Sea.

I. *The Cauſe of the Ebbing and Flowing of the Sea.*

THE *Sea*, in the ſpace of 24 *Hours* and almoſt 50 *Minutes*, does flow and ebb twice.

The Cauſe of this *wonderful Effect*, is aſcribed to the *Body* of the *Moon*; which by preſſing the *Matter* that runs between her and the *Earth*, doth drive the *water* alſo towards the *ſhoars*. For as that part of the *Street* is made more narrow, which hath ſome part of its breadth taken up by ſome thick *Body*; and as that *Wind* is the ſtrongeſt and moſt forceable, which paſſeth through a narrow place; ſo likewiſe, becauſe the preſence of the *Moons Body* doth ſtreighten the ſpace that is between her and the *Earth*, the *Air* and the *Water*, which are *fluid Bodies*, muſt needs give way, and riſe higher towards the *ſhoar*. In the very ſame manner as we ſee, that *water*, or any other *Liquor*, poured into a *Veſſel*, riſeth about the ſides of the *Veſſel*, if it be preſt by any thing, and leaving the middle of it, is carried towards the Edge of it. But to clear this yet further, let us ſuppoſe T to be the *Earth*, and E F G H, the *water* which compaſſeth the *Earth*; B, the *Moon*, running through her *Circle* in a *Months* time; N O P Q, the *Vortex* of *Heaven*, which hath the *Earth* T for its *Center*, and which together with the *Moon* is continually whirled about the *Earth*. For the ſame *Heavenly matter* which tends to O, and thence continues its courſe to P and Q, requires as much ſpace on one ſide of the *Earth*, as on the other, and ſo would preſs it every where alike. But becauſe the *Moon* is at B, and doth not move ſo ſwift as the *Heavenly matter*; therefore the ſaid *Matter* cannot but preſs the *Earth* more towards P, than towards O or Q, and conſequently the *Earth* muſt remove a little from the *Center* of the *Vortex*, and come nearer to D; and by this means depreſs the *water* which is at F and H. Moreover, becauſe the *Earth* is whirl'd in 24 Hours about its own *Center*, that part of it which is now at the Point F, where the *Sea* falls, within 6 Hours, will be at the Point G, where the *Sea* ſwells; and after 12 Hours at the Point H, where it falls again. And foraſmuch as the *Moon* all this while makes ſome ſmall progreſs alſo, and finiſheth her Circumvolution about the *Earth* in the ſpace of almoſt 30 Days, we muſt add 12 Minutes of an Hour to the time of each Ebbing and Flowing; ſo that the *Sea* takes up 12 *Hours* and 24 *Minutes*, in her *Ebbing* and *Flowing*, at one and the ſame place.

Flowing of the Sea, is the Moon.

Figure 46. in the Inſtitution.

II. *The Moon is the Cauſe of this Reciprocation.*

Whence it is evident, that this *motion* of the *Sea* muſt be attributed to the *Moon*; ſeeing that we find, that the *Tide* riſeth every Day one Hour later, according to the *motion* of the *Moon*. For ſuppoſe we the *Tide* to come in to day at 12 of the *Clock*, to Morrow it will not begin till One, which is a ſufficient Argument, that the *Tide* proceeds from the *Moon*.

III. *Whence the great difference of the Tides doth ariſe.*

The *Tide* doth not always obſerve the ſame time, but comes to ſome *Shoars* ſooner, and to others later.

This difference may proceed from many Cauſes; but chiefly from the *unevenneſs* of the *Bottoms* or *Channels*, wherein the *waters* are contained, or from the ſituation and diſpoſition of the *ſhoars*, by which the motion of the *water* is much advanced or hindred. Whereof we have an Inſtance in the *Banks* of *Rivers*, between which the *water*, according to the diverſity of their ſituation, either runs headlong, or flows gently; goes winding, or elſe ſtrait along.

IV. *What is the reason of the great Tides that are one the Coasts of Normandy.*

Hence it is also that they have such great *Tides*, on the Coasts of *Normandy* and *Britanny*, so as that about S. *Michael*, and S. *Macluo*, the *Tides* rise sometime above 60 Foot high. For the *Sea* being driven from *South* to *North*, are beaten back by the *British Shoar*, and afterwards rebounding from the *Coasts* of *Normandy* and *Britany* they joyn in one *Angle*, and because of the narrowness of the place do swell and encrease.

V. *The flowing of the Sea tends at the same time from the East to the West, and from the Tropicks to the Poles.*

The *Tide* doth not only tend from *East* to *West*, but also at the same time from the *Tropicks* to the *Poles*: But yet so, as that in certain places, the one of these is greater and more sensible than the other, which depends on the position or direction of the *Coasts*. As for Example, in the *Atlantick Ocean*, the *Tide* seems only to tend from the *Tropicks* to the *Poles*, and this because the *Coasts* of *America* do resist its *motion* from *East* to *West*. But on the contrary in the *Magellan Straits*, no other *motion* is perceived but from *East* to *West*; because the *Coasts* there resist the *motion* from the *Tropicks* towards the *Poles*.

VI. *Why there is no Tide in the Mediterranean.*

The Reason why only a very small *Tide*, or none at all is perceived in the *Mediterranean* is, because it contains many *Islands*, which resist and hinder it, as also because of the narrowness of its *Channel*, which does not afford the *waters* room enough to display themselves in. For tho' that part of the *Mediterranean*, which is beyond the *Tropicks*, hath entercourse with the *Ocean* by means of the *straits* of *Gibraltar*; yet because that passage is not above 3 or 4 *Leagues* over, all the *water* that can enter this way within the space of 6 *Hours*, is very inconsiderable, if considered with the height and breadth of that *Sea*. And moreover, as soon as the *water* is entred, it finds the *Sea* broad, and the *Shoars* so disposed, that it only moves along the *Shoars*; and therefore it is necessary, that there be only a continual course of the *water*, without any *Flood*.

VII. *Whence the Tide proceeds, which is found in the Gulf of Venice.*

But yet we must here except the *Gulf of Venice*; for seeing that the *waters* that are there, being beaten back from the *Coasts* of the *Morea*, do soon reach the end of that *Channel*; it must needs follow that because the first rebounds are seconded and supported by the *latter*, they must cause a sensible *Tide*, as experience doth witness they do.

VIII. *On the Coast of Provence there is but a small Tide.*

On the *Coast* of *Provence* in *France*, a small *Tide* only is observed, especially at the *New* and *Full Moon* of the *Æquinoxes*; for seeing that from that *Shoar*, to the opposit *Coast* of *Africa*, there are almost 8 Degrees of *Latitude*, without any *Island* lying between; and because it hath an open way from *South* to *North*, the *Sea* there, about the *Æquinoxes*, flows about 2 Foot high.

IX. *Why there is no Tide in the North Sea.*

So likewise in the *North Sea* beyond *Scotland*, towards *Norway* and *Greenland*, scarcely any *Tide* at all is observed, because that part of the *Earth*, is at a great distance from the Tract the *Moon* moves in; or because that *Sea* is extended from *West* to *East*, and is interrupted with many *Islands*, and jetting Points of *Land*: Whereas in *Hudsons Bay*, a great *Tide* is observed, because that *Sea* lies open from *East* to *West*.

X. *Why the Tide varies in some places.*

And much a like account must be given, of that great variety of *Tides* observed in other places, for that the *Sea* flows many Foot high at *Venice*, and at *Ancona* riseth but little or nothing at all; that on the *Coast* of *Syria*, it flows much higher, than in several parts of *France*, where it scarcely riseth 1 Foot high; the reason of this is, because the *Coast* of *Syria* is at the end of the *Mediterranean Channel*, and those of *France* about the midst of it; as we find in a *Boat*, that the rising and falling of the agitated *water*, is only perceived in the extreams parts of it, not about the midst, where the *water* is smooth and even.

XI. *The Sea water sometimes takes up more time in flowing than in Ebbing.*

Accordingly also, a Reason may be given why the *Tide*, in the *River* of *Garonne* in *France*, flows almonst 120 *Miles*, in the space of 18 *Hours*, whereas the ebbing is performed in 12 only. For if the motion of this *Tide* be exactly Calculated it will be found, that if the *Flood* comes in at the *New Moon* at 3 of the Clock at Midnight, it will proceed almost 50 *Miles* in 6 *Hours*, that is, by 9 a Clock in the Morning; and afterwards in so many *Hours* more, will come to *Bordeaux*, and at 3 a Clock in the Afternoon it turns the *Ships* about, which shews that the *Tide* is coming in: And then at 9 of the Clock it reaches as far as the Town of S. *Merceur*, but is very weak and small there; and without making any stay there, is presently followed with the *Ebb*, which it is evident must not take up so much time by 6 *Hours* as the *Flood* did; because the *water* by its innate *heavinesse* runs more swiftly to the *Sea*, than from the *Sea* into the *Rivers*. For the *Sea* being low, and much deeper than the *Rivers*, it cannot be otherwise but that the further the *Tide* reacheth up in *Rivers*, the more slow must its motion be, because it mounts all the way, and moves uphill. For the flowing of the *Tide* continues, till the *water* of the *Rivers* and of the *Sea* be of one and the same height.

XII. *Why the Tide at Havre de Grace in France doth set sooner at the Full Moon, than at Diep.*

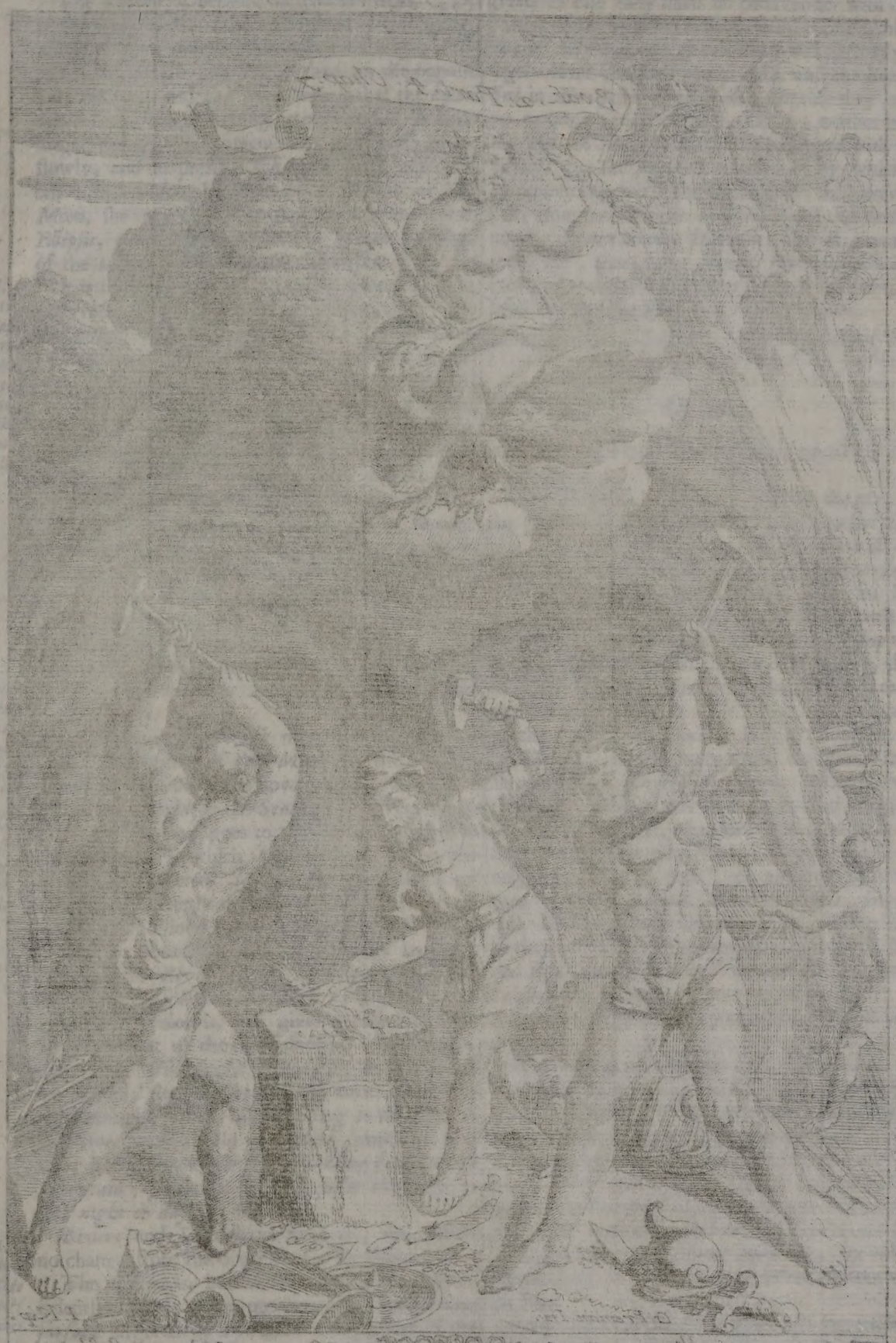
Havens that are under the same *Meridian*, have not always their *Tides* at the same time, as is evident in that famous *French Haven* of *Havre de Grace*, which at the *Full* and *New Moon* hath *high water* at 9 a Clock in the Morning; whereas at *Diep* it is not *high water* till 10 a Clock, tho' these *Havens* be but at a little distance from one another, and scarcely differ half a Degree.

The reason hereof is, the many windings and turnings that are in the *Channel*, which change and turn the course of the *water*: As likewise the violence of the *Winds*, which is very considerable there. Thus at *Calice* and *Sluys* in *Flanders*, at *Full* and *New Moon* it is *high water*, about 11 a Clock, the *Moon* being enlightned on that part which looks *Southward*; at *Arnmuyden* and *Middelburg*, at 2 a Clock in the Afternoon or Morning; at *Zierick-zee* at 3 a Clock when the *Moon* is at *South-west*, and the *Sun* enters *Capricorn*; at *Bergen* 2 *Hours* and an half later; at *Antwerp* and *Dort*, the *Moon* being turned toward the *Æquinoctial West*, almost at 6 a Clock; at *Mechelen* at 8, but yet so as that the *Tide* sometimes comes in faster, and at other times slower, according as the Weather is Fair and Calm, or Stormy.

XIII. *The Tides are greater at the New and Full Moon than at other times.*

The greatest *Tides* are at the *Conjunctions* about D, and at the oppositions about B, that is, at the *New* and *Full Moon*, than at the *Quarters*, or *Quadrate Aspects* at A, and C. And therefore the *Sea men* at the *New* and *Full Moon*, because the *Tides* are then greater and swifter, call it a *live Sea*, and at the Quarters a *dead Sea*.

The



To the Right Hon.ble Henry Lord Viscount Sydney of Sheppey, Baron of Milton, L.d Leivtenant of Kent, Constable of Dover Castle, Lord Warden of y.e Cinqueports, M.r General of their Ma.ties Ordnance, Collonel of their Ma.ties first Regiment of foot Guards, one of the Gentlemen of his Majesties Bedchamber, and one of the Lords of their Majesties most Honourable privy Councell &c.a

This Plate is humbly Dedicated, by Richard Blome.

XIV. What is the Reason of the great Tides that are in the River Seine about the Æquinoxes and Solstices.

XV. Whether the River Euripus Ebb and Flow so many times a day, as some antient Historians have left upon Record.

XVI. Why there is no Tide in Rivers and Lakes.

XVII. Nor any Tide in the Dead Sea, nor in the Euxine Sea.

The Reaſon is, becauſe the *Heaven* A, B, C, D, is not of a *Spherical*, but almoſt *Elliptical figure*, and hath more room in that part of it, which is between the *Earth* and A, C, than in the oppoſit part about B, and D. Now ſeeing that the *Moon* when ſhe is about the *Quarters*, moves in theſe larger ſpaces, ſhe conſequently advanceth more ſlowly, and ſo preſſeth the *waters* leſs, and cauſeth a leſs *Tide*. Whereas at the *New* or *Full Moon*, ſhe moves in the narroweſt part of her *Ellipſis*, and therefore cauſeth a greater preſſion of the *waters*, and a greater and ſwifter *Tide*.

XIV. *What is the Reaſon of the great Tides that are in the River Seine about the Æquinoxes and Solſtices.*

It is for the ſame Reaſon, that 3 great *Tides* are obſerved in the River *Seine* in *France*, about the *Æquinoxes* and *Solſtices*: For the 1*ſt* of them riſeth almoſt 4 Foot high, the 2*d* 8, and the 3*d* 12 and upwards, and that with ſo great ſwiftneſs, that in 4 *Hours* it advanceth 25 french Leagues with a great Noiſe. For ſeeing that the *Tides* exceed about the *Æquinoxes*, and about the *Full* and *New Moon*, the motion of the *waters* muſt be greater alſo; and ſeeing alſo that the *Channel* of the *River Seine* with reſpect to its Mouth, where it enters the *Sea*, doth reſemble a *Trumpet*, which grows narrower and narrower by degrees, it cannot be otherwiſe, but that the *waters* muſt ruſh in with a great force into ſuch a narrow *Chanel*.

XV. *Whether the River Euripus Ebb and Flow ſo many times a day, as ſome antient Hiſtorians have left upon Record.*

The *River* or rather the narrow *Sea Euripus*, if we may believe the *Antients*, *Ebbs* and *Flows* 9 times a day.

The cauſe of this effect may alſo be aſcribed to the Interpoſition of the *Moon*, by the preſſing whereof the *River* runs down, not towards one part of the *World*, as the *Seas* do, but every way; ſo as that one part goes to the *South*, another to the *North*, *&c.* which as they light upon the *Straits* of a narrow *Sea*, or upon neighbouring *Shoars*, accordingly the *Ebbing* is haſtned or retarded. Tho' indeed we may have good reaſon to queſtion, whether what the *Antients* have related of this *River*, be all agreeable to Truth; ſeeing that TITUS LIVIUS in his 8*th* Book, *Decad* 3d denies it, and gives us ſufficient occaſion, to doubt of the faithfulneſs of *Authors* as to that Point. *The Strait of Euripus*, ſaith he, *doth not ebb and flow at ſet times 7 times a day, as the common report is, but according to the Wind is ſometimes hurried this way, and ſometimes that way, like a Brook that falls headlong from a ſteep Mountain; ſo that it does not ſuffer the Ships to reſt night or day.*

XVI. *Why there is no Tide in Rivers and Lakes.*

Rivers and *Lakes* have no *Tides*, and receive no change from the oppoſition of the *Moon*.

The Reaſon is, becauſe their *Banks* are not ſufficiently diſtant from one another, nor is their *ſurface* large enough to admit the preſſure of the *Heavenly matter*. For even as *Veſſels* the narrower they are, the leſs motion is perceived in them; ſo no other *water*, but the *Sea* which ſurrounds the whole *Earth* can have ſo much room, as at the ſame time to riſe or ſwell in 2 ſeveral places, and to fall or ſink in 2 others. And therefore it is that the *Rivers*, *Bays* and *Lakes* that are between the *Tropicks*, cannot admit of any *Ebbings* and *Flowings*.

XVII. *Nor any Tide in the Dead Sea, nor in the Euxine Sea.*

As to thoſe *Lakes* and *Rivers* that are without the *Tropicks*, neither are they ſubject to *Tides*, no nor the *Seas* neither, that are conſiderably great, in caſe they have no entercourſe with the *Ocean*, or if they have any, yet the communication of the *waters*, is by a ſtrait and narrow paſſage. Thus the *dead Sea* in *Aſia*, and the *Euxine Sea* in *Europe* have no *Tides*, becauſe they have no communication with the *Ocean*; neither hath the *Baltick Sea* any, for tho' it be united with the *Ocean*, yet the *ſtrait* of the *Sound* by which it communicates with the *Ocean*, is ſo far turn'd aſide, from the *Straight Line*, in which the *waters* move that are driven from the *Tropicks* towards the *Poles*, that they cannot enter in ſufficient quantity into it, within the time of 6 *Hours*, to cauſe any ſenſible Elevation of the *waters*.

CHAP. VII.

Of Fire.

I. *How Fire produceth or propagates Fire.*

ONE *Fire* is produced or propagated by another.

The Reaſon hereof is, becauſe the parts of the 3*d Element*, being carried away by the *Firſt* that ſurrounds them, meet with like parts of the 3*d Element*, which they not only ſeparate from their like parts, but alſo from thoſe of the 2*d Element*, ſo that theſe alſo being ſurrounded with the *firſt*, are ſnatch'd away by it. For as a *Ship* that is carried along by the ſtream of a *River*, doth more forceably puſh forwards other *Bodies* it meets with, than the *River* it ſelf can; ſo theſe parts of the 3*d Element*, being hurried along by the 1*ſt Element* that ſurounds them, do agitate more ſtrongly than the *firſt* alone can. Wherefore, if the force of theſe parts that are hurried away by the firſt be ſo great, that they be able to puſh far from them all the parts of the *ſecond*, which the neighbouring *Air* is full of, and keep them ſo; then the *Flame* appears, as we ſee in *Wax*, *Greaſe*, *Oyl*, *Brimſtone* and *Gunpowder* ſet on *Fire*: But if they be not of force enough to do this, then the *Fire* lies overwhelm'd with much *Aſhes*, as in *Leaves*, *Touchwood*, or any other dry *Fewel*.

II. *How Fire is generated by concentration of the Beams of the Sun.*

Fire is alſo generated by concentring the *Rays* of the *Sun*.

The Reaſon is, becauſe *Light* is nothing elſe but the motion of the 2*d Element*, produced by the 1*ſt*, whereby the 3*d Element* is made viſible. For it may happen, that upon the uniting of ſeveral *Rays*, ſome part of the 3*d*, may be ſeparated from its other like parts, and from the 2*d*, and conſequently be ſurrounded only with the 1*ſt*, whoſe motion it muſt then follow. Thus in our time *Burning-glaſſes* have been invented, by which *Metals* may be *Melted*, and *Wood* ſuddainly ſet on *Fire*.

III. *There be ſome Fires that ſhine without heat.*

Some kinds of *Fire* do *ſhine*, and yet are deſtitute of all *heat*. For they who uſe the *Sea*, obſerve that at ſometimes when *Waves* are daſht againſt *Rocks*, they appear as if flames of *Fire* rebounded from them. And thus alſo Rays of Light proceed from *Rotten-wood*, and *Saltfiſh*, but without any ſenſible *heat*.

The Reaſon is, becauſe the *Matter* of the 1*ſt Element*, which is ſhut up in the *Pores* of ſuch *Bodies* as theſe, tho' they be of force enought to puſh the *Globuli* of the 2*d Element*, and to move the *Retina*, as much as is ſufficient to produce the perception of *Light*; yet is it too weak, to ſeparate the

the *Earthly parts* from one another, and to excite that agitation in them, which is ſtrong enough to produce *heat*. *Fire* therefore only *ſhines*, when the *Pores* of the *Terreſtrial Particles* are ſo narrow, that they can only admit the firſt *Element*, and ſhut out every thick *Body*. Thus when the pointed *Needles*, as it were, of *Salt* do enter the *ſtrait Pores* of *Fiſhes*, and drive thence the *Globuli* of the *2d Element*, ſo as to be open only for the admiſſion of the matter of the *1ſt Element*, they by this means make the *Fiſhes Scales* to ſhine like *Glow-worms*. *Hiſtorians* tell us of a certain *Fly* in *New Spain*, of the bigneſs of a *Beetle*, called *Cocujus*, whoſe *Eyes* do enlighten the *Night* like a *Wax Candle*, ſo that it ſerves for a *Lanthorn* to thoſe that walk by *Night*, and for a *Lamp* to burn in ones *Chamber*; and by the *Light* whereof one may *read* or *write*; and have the ſame effect when the *Inſect* is dead, as when yet alive.

IV. *Some Fires burn without giving Light.*

Some *Bodies* afford great *Heat*, but are diſtitute of all manner of *Light*: As the *Blood* of *Live Animals*, *Horſdung* tending to putrefaction, *Quick-Lime* ſprinkled with *water*, in which things there is a hidden *Fire* that burns and ſcorcheth, without the appearance of any *Flame*.

The Reaſon is, becauſe in ſuch *Bodies* as theſe, the parts that ſurround the *1ſt Element*, and that are agitated by it, are too ſoft and limber to tranſmit the *Action* of *Light*. For tho' ſome of them ſwim on the top of the *matter* of the *1ſt Element*; and comply with its *motions*; yet becauſe ſome *Watry* and *Aiery* plyable parts, are mingled with them, they have the power to kindle *heat* and *fire*, but not of receiving the action of *Light*. Hence it is that when the *Spirit* of *Vitriol* and *Oyl* of *Tartar* are poured together, an effervescence or boyling is cauſed, becauſe the free paſſage of the *ſubtil matter* being hindred in them, doth produce a wreſtling or conteſt betwixt theſe 2 Liquors, which is the cauſe of a vehement *heat*. And for this Reaſon *Horſdung*, and the *Blood* of *Live Animals* are hot, becauſe the *1ſt Element* is pent up by a ſofter *matter*, within the narrow *pores* of the *parts*. And therefore they are only *hot*, that is they have only the force to move thoſe *Nerves* that are ſubſervient to the *Touch*, but not of puſhing the *Celeſtial Globuli*, wherein the nature of *Light* doth conſiſt. *Quick-Lime* ſprinkled with *water*, waxeth *hot*, becauſe its parts are ſo ſuited and diſpoſed, as to admit the *water* ſurrounded only with the matter of the *1ſt Element*; ſo that the *Globuli*, being expelled, the matter of the *1ſt Element* only bears ſway. For thoſe *Bodies* are ſaid to have the form of *Fire*, whoſe *particles* do ſeparately comply with the motion of the *1ſt Element*, and imitate the agitation thereof.

V. *Why the Flame mounts upwards.*

Flame, by a natural propenſity, mounts upwards towards *Heaven*; and to the end it may the ſooner get thither, it quits its thickneſs, and takes to it ſelf a *Conical Figure*.

It may be ſaid that the *Flame* doth not ſo much affect to mount upwards, as it is by outward force driven up thither; for being on all ſides ſurrounded by the *Air*, and by reaſon of its leſs degree of agitation, as it were, continually beaten by it, it rather tends upwards than downwards, becauſe it meets with leſs reſiſtance there. The way this is performed take as follows. The matter of the *1ſt Element*, which is predominant in the *Flame*, being in perpetual motion, ſtrives continually to depart from the place where it is; and being lighter than the *Globuli* of the *2d Element*, it is carried upwards, and withdraws it ſelf from the *Center* of the *Earth*; and foraſmuch as no *Body* can be moved, except ſome other, by a circular motion, enter into its place, as much *Air* returns towards the *Flame*, as there is *Smoak* that goes from it; and therefore the *Air*, which, as it were, licks the upper part of the *Candle*, mixing it ſelf with the parts of the *Wax* or *Tallow*, affords *fewel* to the *Flame*: So that the power of dilating the *Fire*, and driving it upwards, may in ſome ſort be attributed to the *Air*. Now the reaſon why the *Flame* is of a *Conical Figure*, and ends in a ſharp point, is evident, becauſe the middlemoſt parts of the *Flame* have more agitation, and conſequently move with more force, and are ſooner carried upwards, than the *outward* parts, whoſe agitation is diminiſhed by the nearneſs and *contact* of the *Air*.

VI. *A Pyramidal Figure is accidental to Flame.*

From what hath been ſaid, it is evident, that a *Pyramidal Figure* is accidental to *fire*, becauſe the *Air*, by compreſſing the parts of the *Flame*, doth form it into that *figure*. For if we take a *Wax-Candle*, and place it in an *Iron Pipe*, and put the ſaid *Pipe* into a *Porringer* full of *Spirit* of *Wine*, and afterwards ſet the *Wax-Candle* and *Spirit* of *Wine* upon the *fire*, we ſhall find that the *flame* of the *Wax-Candle* will be dilated, and ſwell 4 or 5 times greater than it was, and will then appear of a *round*, and not of a *Pyramidal Figure*.

VII. *The Fire burns more fiercely in the* Winter *than in the* Summer.

In the *Winter*, when the *Air* is moſt compreſt and condenſt with *Cold*, the *Fire* burns moſt fiercely; and in *Rainy Weather*, and more eſpecially when the *Sun* ſhines upon the *hearth* more weakly.

The Reaſon is, becauſe *Sulphureous Particles* are neceſſary for the preſervation of the *Fire*, which do break forth from the combuſtible *matter*; and *Nitrous* alſo, which are mingled with our *Air*: Now ſeeing that the *Air* in *Winter*, doth moſt of all abound with theſe *Nitrous Corpuſcles*, it cannot be otherwiſe, but that the greater quantity of theſe muſt make the *Fire* burn more fiercely. Whereas, when the *Sun* ſhines upon the *Hearth*, the *Nitrous Particles* in the *Air* are ſcattered, and conſequently the force of the *Fire* debilitated and almoſt extinguiſh'd. Hence it is that when a *Lamp* or other *Light* is put into a large *Glaſs*, fit for that purpoſe, as ſoon as the *Air* is pumpt out, it is preſently extinguiſh'd; not ſo much becauſe it is choaked by its own *Smoak*, as becauſe it wants this *Nitrous Aliment* contained in the *Air*.

VIII. *Why a Candle with a long Wick, ſmoaks more than that with a ſhort one.*

A *Candle* that burns with a long Wick, *ſmoaks* more than another that is new ſnuft.

The Reaſon is, becauſe in a longer *Wick*, the thicker parts of the *Candle* being mingled with the *ſulphureous*, are without any loſs carried upwards. But in a ſnuft *Candle*, that more fat and *ſulphureous* matter which conſtitutes the *Smoak*, by being much agitated in the Flame, is reduced into moſt minute parts, as may be eaſily gathered from the crackling noiſe they make. This is the reaſon alſo, why a *Plate* of *Iron*, or other *Metal* being approach'd to the utmoſt parts of the *Flame*, contracts only ſome little ſmuttineſs, becauſe the *Terreſtrial Matter* is by the force of the *heat* reduc'd to ſo ſmall parts, that they are no longer perceptible

ble in their egreſs from the *Flame*, nor adhere to any *Body*: But when this Plate is thruſt into the midſt of the *Flame*, it is covered all over with *Smut* and *Soot*; and that by means of thoſe groſſer *particles*, that are not throughly ſubdu'd by the heat of the *Flame*.

IX. *How a Candle may be made to burn without ſmoak.* But if a *Cotten Wiek* be laid to ſteep 24 hours in *Whitewine Vinegar*, impregnated with half its quantity of pure *Nitre*, and afterwards expos'd to the *Sun* to be dried, it will not ſend forth any *Smoak*, becauſe the *ſaline* and *volatil parts* of the *Nitre* and *Vinegar*, do ſo divide and agitate all the *moiſture*, that no part of it can eſcape the force of the *Flame*.

X. *How two liquors pour'd together, produce heat.* *Spirit* of *Vitriol* and *Oyl* of *Tartar* pour'd together, produce an *Ebullition*, or *Effervеſcence*.

The Reaſon is, becauſe the *pores* of one of theſe *liquors* are ſo formed, that they can only admit the branchy parts of the other *liquor*, wrapt about with the *matter* of the firſt *Element*; by which means the firſt *Element* having repulſt the *Globuli* of the 2*d*, does alone bear ſway. Or becauſe the *ſubtil matter*, being wont to flow and move otherwiſe in the *Spirit* of *Vitriol*, than in the *Oyl* of *Tartar*, when its free paſſage is ſtopt, it cauſeth a kind of conteſt between the 2 liquors, and an efferveſcence or ebullition by reaſon of the mutual agitation of their parts.

XI. *Why Fire is kindled by a blaſt.* *Fire* is commonly kindled by a *Blaſt*, whether of a *Bellows*, or otherwiſe.

Becauſe by this means the *Aſhes* which cover the *ſurface* of the *Coals*, and obſtruct their more open *pores*, is driven away; by which means the *Fire* that was about to break forth, is driven inward, and there ſo ſeparates and divides the parts of the Coals, and throughly penetrates them, as to invade and *kindle* the fat and inflamable *particles* alſo. And hence it is that the *flame*, when blown upon, makes a noiſe, which is cauſed by the reſiſtance of its parts, and the mutual combination that is between them.

XII. *How Fire comes to be quenched.* *Fire* is quenched, when its *parts* are ſcattered and diſperſt, as it is kindled by the uniting of them. Thus we find, that either too fierce and violent a *Blaſt* of *Wind*, or a copious *affuſion* of *Water*, doth diſſipate the *particles* of *Fire*: The ſame effect is alſo cauſed by a ſteam that is ſhut up, and hath no vent to get out by; for then the ſaid *Vapour* being beat back, and rebounding upon it ſelf, doth divide the parts of *Fire*. And by this means it is that a *Candle* is often put out in a *VVine Cellar*, filled with the ſteams of *New VVine*.

XIII. *Smoak hurts the Eyes, and moves Tears.* The *Smoak* that proceeds from *Wood*, makes the *Eyes* ſmart, and produceth *Tears*.

The Cauſe thereof are the *ſharp* and *biting particles* whereof the *Smoak* conſiſts; which, twitching the *ſurface* of the *Eye*, and contracting the ſame, cannot but cauſe *Tears* to break forth. Forаſmuch, as by this contraction, the *Kernels* in the Corners of the *Eyes* are ſqueezed, and conſequently let out the humour contained in them. *Onions* produce the ſame effect, when they are cut, or otherwiſe divided into *Parts*; at which time a ſharp *vapour* or ſteam proceeds from them; which reaching the *Eye*, provokes *Tears*. And probably it is for the ſame reaſon, that ſome *Fumes* are of uſe to ſtill the *Toothach*, whilſt by their *ſharp particles* they do open the *pores* of the *Gums*, and not only make way for the Pain-cauſing Humour to paſs away, but alſo excite it to evacuation. Thus a Fumigation is made with the *Bran of Wheat*, mixt with fine *Sugar*, which is found to be of uſe for this purpoſe.

XIV. *Greek fires, ſo called, cannot be quenched with water.* Some ſorts of *Fire*, by Authors called *Greek-fires*, cannot be quench'd with *water*.

Theſe *Fires* derive this effect from the ſolidity of their parts, and the ſwiftneſs of their *Agitation*, whereby they beat back the parts of the *water*. For one of the chiefeſt things required to the preſervation of *Fire*, is this, that it have a ſufficient quantity of *earthly particles*, which being driven and agitated by the firſt *Element*, have the power to hinder the choaking of it by the *Air*, or other Liquors pour'd upon it. Which force doth moſt of all abound in *Bituminous*, *Oily* and *Sulphureous Subſtances*, whereof theſe *Greek-fires* are compoſed. Foraſmuch as theſe, by reaſon of their Thickneſs, and the ſticking together of their *Branchy Parts*, are moſt proper to keep their ſtation, and ſo to move the *water*, as to beat back the *Ætherial Globuli*, which by their irruption might extinguiſh the *Fire*.

XV. *Why Fire is eaſily quenched in Wine-Cellars.* The contrary hereunto happens in *Vaults* and *Wine-cellers*, eſpecially when the *New Wine* is working in the *Veſſels*; for then not only the *Candles* that are brought lighted into the *Cellar*, are extinguiſh'd, but even *Torches* alſo; becauſe their flames being fill'd with the ſteams of the *New Wine*, do not conſiſt of any ſuch matter as is able to repreſs and put by the *Air* that hangs over them; nor are they ſtrong enough to force it to enter into it ſelf.

XVI. *How Fire is to be ſtruck out of Flint, Steel, Stones, and ſome ſorts of Wood.* *Fire* is ſtruck out of a *Flint*, with a *Steel*; yea one piece of *Steel* rub'd againſt another, doth produce *fire*. There are alſo ſome *Stones*, that are called *Live-ſtones*, that being ſtruck with a *Nail*, or hit with another *Stone*, do ſend forth *Sparks*. And in like manner the *Indians* alſo procure fire by joining 2 Sticks together, and then take a 3*d*, which they very ſwiftly twirl about between them, till they be ſet on *fire*.

The cauſe of this production of *Fire* is, becauſe when the hard and brittle parts of the *Flint*, and the other mentioned *Bodies*, are hit againſt by a hard *Body*, many of the ſpaces, which lie between their *particles*, and which were wont to be filled with the *Globuli* of the 2*d Element*, are made more narrow than they were before; and therefore as ſoon as the *Heavenly Globuli* are driven away by the force of the ſaid *ſtroak*, nothing remains beſides the moſt *ſubtil matter*, for to receive theſe thick *particles*, and to turn them round very ſwiftly. And therefore, foraſmuch as the parts of *Flint* are very ſtiff, and apt to fly into ſhivers, they do indeed give way to the force of the ſtroak, but immediately rebound again; and thereupon being ſeparated from each other, and hurried away by the motion of the firſt *Element*, they turn to Sparks, and conſtitute the form of *fire*. And thus in like manner is *fire* kindled by the vehement rubbing of *Sticks* againſt one another; becauſe by this continued violent motion, their *particles* are firſt drawn together, and afterwards being with great force ſeparated from one another, whirl round; by which means, not only the *parts* of the *Air*, but alſo the *Æthereal Globuli*, that ſurround them, are ſeparated from each other; and being whirl'd round by the vehement agitation of the firſt *Ele-*

ment, turn to ſparks, and exhibit the appearance of *fire*. Thus the *Apulians* wind *Cords* about a Stick; and by ſwiftly twitching them this way and that way, do ſet them on *fire*.

XVII. *Why Hay, when it is ſhut up cloſe, grows hot.*

When *Hay* is laid up before it is thorow dry, it grows *hot*, and *burns*; which never happens when it is ſpread in a large and open *field*.

The Reaſon is, becauſe *Hay*, whilſt it is yet New, doth abound with many *Spirits*, and ſeveral *Juices*; which being accuſtomed to move thorow the *pores* of the Green *Herbs* from their *Roots*, to their upper parts, do ſtill continue in them for ſome time after that they are cut down. Which as ſoon as they are ſhut up in a cloſe place, the *particles* of theſe *Juices*, paſſing from one *Herb* into another, do find the *pores* of them more narrow than they were, by reaſon of the contraction of their *Fibres*, ſo that they cannot enter them, without leaving the *Globuli* of the *2d Element* behind them; and being only ſurrounded with the *particles* of the firſt, and ſo complying with their moſt rapid motion, are of ſufficient force to agitate and heat the thicker parts of the *Hay*. As for Example, if the Interval, which lies between the 2 *Bodies* B and C, be ſuppoſed to repreſent one of the *Pores* of a green *Herb*, and the ſmall ſtrings 1, 2, 3, ſurrounded with little round *Bodies*, exhibit the pieces carried by the matter of the *2d Element*; and the Interval D and E, another narrow pore of an *Herb*, that is in part dried, through which the foreſaid particles 1, 2, 3, paſs, no longer ſwimming on the *2d Element*, but on the *1ſt* only: It is evident, that thoſe that are between B and C, muſt follow the temperate agitation of the *2d Element*; whereas thoſe betwixt D and E, will be forced to comply with the moſt ſwift agitation of the *1ſt Element*. I ſaid, *In caſe the Hay, before it is fully dry, be laid up in ſome narrow or cloſe place*; becauſe as long as it is expoſed in any open place, the *juice* which runs through the *pores* of the *Herbs*, is eaſily diſſipated in the *Air*, without paſſing through the *pores* of the other ſtrings, wherein it might excite a *heat*, and cauſe a Conflagration.

Figure 19.

XVIII. *What the reaſon is why Gunpowder is ſo eaſily kindled.*

Nothing is more eaſily kindled than *Gunpowder*.

The Reaſon is, becauſe it is compounded of *Brimſtone*, *Nitre* and *Charcoal*, which of all things do moſt eaſily take *fire*: For *Brimſtone*, we know, *flames* immediately, becauſe it conſiſts of *particles* of ſharp *juices*, which are wrapt about with the thin and cloſe branchy *particles* of an Oily Matter, ſo as that many *pores* between the ſaid *Branches*, can only admit the matter of the firſt *Element*. But *Nitre* conſiſts of longiſh and ſtiff Particles, which being agitated by the *particles* of *Brimſtone*, do diffuſe themſelves into a larger ſpace. And ſeeing that the *Charcoal* alſo doth abound with many *Pores*, the *Brimſtone* and *Nitre* do readily enter the ſame, and by them are ſtraitned. By which means it happens, that as ſoon as any *fire* toucheth a grain of *Powder*, compoſed of theſe materials, it preſently enters the ſame through the *pores* of the *Coals*, and preſently agitates the parts of the *Brimſtone*, which afterwards move thoſe of the *Nitre* and *Charcoal*.

XIX. *Some Lamps have been found that have burnt many years in Sepulchers.*

Authors tell us of *Lamps*, that of old times were uſed to be put into the *Sepulchers* of the *Dead*, and continued burning many ages, without any diminution of their *Light*. LUDOVICUS VIVES in his notes upon the XXI *Book* of St. *Auſtin de Civitate Dei*, tells us, That upon the breaking open of a certain *Grave*, a *Lamp* was found that had burnt 1500 years, but that as ſoon as it was touched with the hand it mouldred into the ſmalleſt *Aſhes*. FORTUNIUS LICETUS alſo informs us, that about 100 years ſince, in the *Papacy* of *Paul* III, a *Lamp* was found in the *Sepulcher* of TULLIA, *Cicero*'s Daughter, but upon the admiſſion of the *Air*, and *Light*, was preſently extinguiſh'd.

GASSENDUS reckons theſe *Lamps* amongſt thoſe Ludicrous *Lights*, which burn when the *Air* is ſhut out, and vaniſh as ſoon as it is admitted; when according to him, they ought to be rather kindled a-new upon the letting in of the *Air*, and ſo burn the ſtronger. But as for my part I ſee no reaſon why a *fire* or *flame* may not be preſerved in *ſubterraneous places*, where it cannot be impaired or diſturbed by the blowing of the *Wind*, or the diſtemperature of the *Air*. For it may ſo happen, that the *particles* of the *Soot*, which proceed from the *Candle* or *Lamp*, may cloſe together about the Flame of the *Lamp*, and ſo conſtitute a kind of little Vault or Arch about it, by which the *Air* may be kept off from ruſhing upon the *flame*, and ſo overwhelm and choak it. For ſuch an *Arch* as this would be of uſe to infringe the force of the *flame* from kindling the further parts of the *Oyl* or *Wiek*. So that by this means the *1ſt Element* in ſuch a *Lamp*, being wrapt up round like a *Star*, would repel the *Æthereal Globuli* that are round about it, and ſo diffuſe its *Light* throughout the whole *Sepulcher*; which tho' but weak and duskiſh, yet upon breaking in of the *Air*, and the diſpelling of the *Soot*, which did encompaſs it, doth diſcover a bright and ſhining *Lamp*.

XX. *A Flame proceeding from Spirit of Wine, doth not burn a Linnen Rag, but only the Spirit of Wine it ſelf.*

The Flame of *Spirit* of *Wine* doth not conſume a Rag of *Linnen*.

The Reaſon is, becauſe that to the end a *Body* may be fit to feed the *fire*, it muſt have many *particles* fit and ſuited to the *fire* which it is to preſerve, and the ſame ſo joined to one another, or to other thicker than themſelves, that by the driving or impulſe of the *particles* of the ſaid *fire*, they may be ſeparated as well from themſelves, as from the adjoining *Globuli* of the *2d Element*, and by this means take upon them the form of *fire*: Whereas the *particles* of the *Linnen Rag* are not thin enough to be agitated by the *flame* of the *Spirit* of *Wine*, and to be ſeparated from one another.

XXI. *All fat things are not kindled after one and the ſame manner.*

For every *fire* is by ſo much the more ſtrong and vehement, the more *fat* and *tenacious* the matter is that feeds it. Again, amongſt fat *Bodies*, ſome are much more apt to kindle than others. For *Spirit* of *Wine*, the purer it is, and the more highly rectified, the more inflammable it is alſo, becauſe it hath little or no *Phlegm* remaining with it. Thus that kind of *Stone* which is burnt into *Quick-Lime*, cannot without great difficulty take *fire*, becauſe its parts being very cloſely joined together, the fatneſs that is contained in them, cannot eaſily be diſentangled or driven out from them, to the end it may be kindled into a flame.

When

Book. 2. Part. 4. Chap. 8

XXII. *What the Reason is, that ſparks of Fire ſometimes appear upon ſtrongly Rubbing a Cats Back.*

When a *Cats* Back is ſtrongly rubb'd with ones hand, Sparks of *Fire* ſeem to proceed from it.

The Reaſon whereof ſeems to be this, becauſe this Rubbing drives out ſome *Particles* of *Moiſture*, and cauſeth them to be diſſipated into the *Air*; whereupon the *particles* of the *fire*, or if you will, the *Sulphureous*, *greaſy Particles*, wherewith the Hair and Skins of *Animals* do abound, and thoſe of *Cats* more than any other, croud and meet together, whence proceeds *fire*, and from the *fire*, *light*. Now this *fiery Steam*, or *Exhalation*, is eaſily retain'd or kept cloſe in this *Thicket of Hair*, which conſiſting wholly of *Sulphureous filaments*, becomes eaſily entangled amongſt the ſaid *Hairs*. Which is the true Reaſon, why a *Garment* lin'd with *Fur* doth ſo obſtinately retain the *heat* committed to it, and keep off the Cold. But it is to be noted, that theſe *ſparks* of *Light*, which by ſtroaking are forc'd from the *Back* of a *Cat*, do only appear in the Dark, becauſe a greater *Light* obſcures and ſwallows them, as the *Light* of the *Sun* does that of the *Stars*.

CHAP. VIII.

Of Earthquakes, and Subterraneous Fires.

I. *The Cauſe of Earthquakes.*

THE Country of *Campagna di Roma*, in *Italy*, Trembled for many days, by an *Earthquake* in the beginning of the year, when L. CORNELIUS and Q. MINUTIUS were *Conſuls*, and that with ſuch frequent and reiterated Concuſſions, that, as LIVY acquaints us, the *People* were not only tired and afflicted with the frequent returns of the *Earthquake*, but alſo by reaſon of the Holy-days that were appointed upon that account, to deprecate the Wrath of *Heaven*.

Some do impute the Cauſe of *Earthquakes* to the *Sun*, as ſuppoſing that by his *heat*, he doth attract thoſe *Exhalations* out of the *Caverns* and *Holes* of the *Earth*, to the *ſurface* of it. But Reaſon aſſures us that this cannot be, becauſe the *Sun*'s *Rays* cannot penetrate ſo great a Depth of *Earth*: For tho' the *Earthy particles*, being beat upon by the *Rays* of the *Sun*, do agitate others which are near to them, and to which the *Rays* themſelves cannot reach; and theſe again, others that lye near to them, and ſo on; yet is not this Commotion of the *parts* of the *Earth* ſufficient to kindle a *fire* in it. Wherefore it ſeems more Rational for us to attribute the *Cauſe* of theſe *Earthquakes* to thoſe *Exhalations*, which mounting through the *Chinks* and *Cavities* of the *Earth*, do there compoſe fat and thick *Fumes*, not much unlike to thoſe which proceed from a *Candle* newly extinguiſh'd, and fill the whole ſpace that is about it, which by a *ſpark* of *Fire*, either from *Flints* hitting againſt each other, or by ſome *Candle* that *Miners* make uſe of in their labour, are preſently kindled; and being thereby vaſtly *rarefied*, ſhatter to pieces all the confinements of their too narrow Priſons, and force all the *Bodies* that ſtand in their way.

Thus AGRICOLA tells us, that in the Country of *Miſnia* in *Germany*, there is a *Mountain* of *Smiths-Coals* that burns continually; where, according as the *Flames* ſpread and conſume the *Coals*, the *Earth* ſinks down and leaves deep Holes, which appear like ſo many burning *Furnaces*; the *flame* whereof ſets any fit Matter on *fire*, that is at 4 Foot diſtance from them. In like manner, in the Iſland *Del Moro*, the *Fire* burſts forth with ſuch extream Noiſe, that it equals the Thundering of the greateſt *Cannon*, and with ſo thick a *Smoak*, that it may be compared with Midnight-Darkneſs; and with ſuch a prodigious quantity of *Aſhes* and *Cinders*, that *Houſes* are cruſh'd under the weight of it, *Cattle* and other *Beaſts* deſtroyed, and *Freſh-waters* turned into *bitter*.

II. *Miſnia in Germany, and the Iſland* del Moro, *have ſubterraneous Fires, that burn in the Bowels of them.*

Now whenever the *Exhalations* that are kindled in theſe *Caverns*, are not of force enough to break their way through the *ſurface* of the *Earth*, they only produce a *ſhaking* or *trembling*, that is, they only cauſe the *Earth* that is above them to riſe; In like manner as *Gunpowder* heaves up the *Ground* under which the *Mines* are laid: And the ſaid *Exhalations* appear outwardly, when they have ſtrength enough to open the *ground*.

In *Earthquakes*, there are many times repeated *ſhakings* ſucceeding one another.

III. *Why in ſome Earthquakes there be ſeveral ſucceſſive ſhakings.*

The Reaſon of this is, becauſe the *Matter* that is kindled, is not always altogether in one and the ſame *Cavity*; but in many, which are only ſeparated by a little *ſulphureous Earth*: And therefore when the *Fire* takes in one of theſe *Cavities*, it gives the firſt ſhake to the *Earth*, and a ſecond, when it kindles that which is in the next, after having conſumed the *ſulphurour Matter* that did ſeparate them, and ſo on to the very laſt Cavity.

Some parts only of the *Earth* are ſhaken in *Earthquakes*, not the whole *Ball* thereof.

IV. *An Earthquake never aſſaults the whole Earth, but only ſome particular parts of it.*

The Reaſon is evident, for that the *Exhalations* which abound in the *Earth*, and which have the power of *ſhaking* it, do not every where meet with a ſpace wherein to dilate themſelves. For ſince there are innumerable *ſubterranean Cavities*, and various *hollows* and *windings*, ready to admit any foreign *Bodies*, we cannot well conceive them to be all fill'd with the ſame *Matter*. For ſome of them contain *Waters*, which becauſe of their innate *Coldneſs*, and the thickneſs and fœculency of their *parts*, do ſtagnate without any *motion*. Others are full of a thick and foggy *Air*, which being pent up within narrow *Walls*, is never driven out of its *Holes* without ſome force. Others again are taken up by *fire*, or rather *fiery Steams* and *Exhalations*; but ſuch as are ſhut up in their *Dungeons*, and being unable to break forth, lye very quiet there without doing any miſchief. Now theſe *Steams* or *Exhalations*, pent up within the *Bowels* of the *Earth*, from the various coalition whereof, *Brimſtone*, *Jews-lime*, and other ſuch like *inflamable Bodies* are made, like a *ſmoaking Torch*, are kindled either by another *Fire*, or by the ſtriking of *hard Bodies* againſt one another, or by the mixture of *Liquors* proper to produce an effervеſcence, and a conſequent *flame*; and by means whereof being now more dilated, they puſh againſt the ſides of their *Dungeons* and ſhake the *Earth*, till at laſt having broke through

through their *Prison-walls*, they burst forth, and rush to take possession of a free and open *Career*. And forasmuch as these *Exhalations* are very inconsiderable, and bear no proportion to the whole *Globe* of the *Earth*, they can only shake some parts of it, without concerning the whole.

V. *What places are most subject to Earthquakes.*

Sea-Coasts of all other places are most subject to *Earthquakes*, because much fat and slimy Matter flows from the *Sea*, into the several *subterraneous Cavities*, which are very proper to feed the *Fire*. And therefore we find that *Earthquakes* very seldom are heard of in the *Northern* parts of the *World*, especially those that are remote from the *Sea*; because they have not Matter enough to produce these Concussions, the same being either drawn off by the *heat* of the *Sun*, or else because it is but gradually and in small quantities conveyed from the *Sea*. To which we may add, that in the Parts now mention'd, there are but few *subterranean Caverns* to admit this Matter: For this looseness of the *Earth*, and the wide and open *Cavities* contain'd in the *Bowels* of it, do much conduce towards the causing of these *Earthquakes*; because fresh *Matter* is laid up in store in them, for the producing of these Effects.

VI. *When and where Earthquakes are most frequent.*

Accordingly we find, that *Earthquakes* are most frequent in those places where the *Earth* abounds with *Caverns* and *subterraneous Cavities*, which are the proper and fit receptacle for those *Exhalations*; except the said *Cavities* be open towards *Heaven*, and so afford a free passage for the *Exhalations* to fly away. Wherefore also *Earthquakes* chiefly happen, when abundance of such *Exhalations* are found in the *Earth*; as in the *Spring* and *Autumn*.

VII. *What is the Cause of the great Noise that is consequent upon Earthquakes.*

Every *Earthquake* is followed by a Noise, not much unlike that of *Thunder*, which always accompanies, and sometimes goes before it.

The Reason hereof is, because the *Fire* which is rarefied within the *Cavities* of the *Earth*, doth rebound and return upon it self: For seeing that in these *Caverns* there be innumerable winding Passages, which the kindled *Exhalations* go through, it cannot be but that the *sound* must needs be multiplied in its passage through them. Thus we know that *Eccho's* are most frequent in *Caves* and *Hollow places*: And thus we find, that from certain crooked *Horns*, which the *Musicians* from their windings call *Serpents*, a kind of Lowing Noise doth proceed, which is only to be attributed to those windings and turnings by which the said *sound* is conveyed to our *Ears*. Every *Earthquake* therefore is accompanied either with a greater or less *Noise*, according as the *matter* is more swiftly or more slowly kindled, and as the rarefied *Exhalations*, do break forth with greater or weaker force, and display themselves by many or fewer Concussions.

VIII. *Whence that great Fire that proceeds from Ætna and Vesuvius, is caused.*

The *Earth* in many places casts forth *Fire* through the top of many *Mountains*: Thus Mount *Ætna* in *Sicily*, *Vesuvius* in *Naples*, *Hecla* in *Iseland*, *&c.* do disgurge *Flames*, and cover the Neighbouring *Countries* with *Ashes*. The Mountain *Vesuvius*, now called *Monte di Soma*, according to the Relation of DION CASSIUS did burn in the year that TITUS VESPASIANUS and FLAVIUS DOMITIANUS were the *7th* time *Consuls*, and breaking forth at the top, at first cast forth *Stones*, and afterwards such a vast quantity of *Flames*, that 2 Towns, *Herculaneum* and *Pompeium* were thereby consumed; such thick *Smoak*, that they darkned the Light of the *Sun*, and last of all pour'd forth such a storm of thick *Ashes*, that it cover'd all the Neighbouring Country like a high *Snow*, and which by the force of the *Wind* was carried over into *Africa*.

There is no question to be made, but that *Fire* is generated in the *Earth*, seeing that a vast quantity of *Brimstone* and *Jews lime* is contained in the same, which are of a very Fat substance above all others, and are most readily kindled: Neither do we find any *matter* within the *Bowels* of the *Earth*, is better suited for the production of *Fire*; and therefore we may well conclude, that whatsoever *burns*, or is *hot*, is preserved and maintained by the mixture of both these. And therefore no *Fire* breaks forth any where, neither doth any *heat* manifest it self, where both of these, or at least the one of them doth not bear sway. The *Wind* also may contribute not a little to the increase and dilatation of the *Fire* that lies hid in the *Caverns* of the *Earth*, whilst by entring into them, it doth more or less blow them up and kindle them, and makes the *flame* more violent.

IX. *When Ætna first began to burn.*

When *Fires* first began to break forth from this *Mountain*, doth not appear from *History*: VIRGIL tells us, that in ÆNEAS his time, when in his Voyage to *Italy* he put in at *Sicily*, Mount *Ætna* poured forth *Smoak* and *Cinders*, with a horrid roaring Noise. And THUCYDIDES acquaints us, that this Mountain burnt in the *76th Olympiad*, that is, 476 years before the Birth of *Christ*. And several times after that, as in the time of CALIGULA, &c.

X. *When the Mountain in the Isle of Java began to burn.*

In the Year 1580, a *Mountain* in the Isle of *Java*, not far from the City *Panacura*, began to burn, the top of it being burst open with a violent eruption of *Brimstone*, so that 10000 Persons were consumed in the Country thereabouts, and cast forth vast great *Stones* upon the City *Panacura*. Moreover, for 3 days together it sent forth so much thick *Smoak*, mixt with *Flames* and *Cinders*, that it did cover the *Sun*, and almost turned the *Day* into *Night*.

XI. *Of some Mountains that burnt formerly, and have now ceased.*

There are found some other *Mountains*, that now burn no longer. Thus in the Island *Queimoda*, not far from the Mouth of the River *Rio de la Plata*, there is a Mountain that burnt formerly, but hath now ceased. So likewise there are several *Mountains* in *Congo* and *Angola*, as also in the *Azores*, especially those of *Tercera* and St. *Michael*, which formerly cast forth *flames*, whereas now nothing but *smoak* proceeds from them; and this, because the *Sulphurous* and *Bituminous matter*, which is the most proper to kindle and feed *Fire*, is quite consumed in them.

XII. *Why these subterraneous Fires do commonly break forth at the Tops of Mountains.*

The Reason why these *Subterranean flames*, do generally get up to the tops of *Mountains*, and thence make their terrible *Eruptions*, is to be taken from the Nature of *Fire*, which being pent up in these *Cavities*, and not being able to dilate and spread it self, makes a breach in the *Walls* of its *Prison* upwards, rather than elsewhere, because there it finds less resistance, and being once broke forth, it continues burning as long as the *fewel* lasts.

The

XIII. *Why the Fire doth not break forth from lower Grounds, as well as from Mountains.*

Subterraneous Fires ſeldom break forth from lower *grounds*; but very frequently from the Bowels of *Mountains*.

Of this, a twofold Reaſon may be given; *Firſt*, Becauſe *Mountains* contain many *Cavities*: And, 2*dly*, becauſe thoſe great *fragments*, whereof the outward Cruſt of the *Earth* doth conſiſt, and which are ſo poſited as to lean upon one another, do afford a more eaſie Egreſs to the *flame*, than the other parts. And tho' theſe Openings of the *Earth*, do cloſe again, as ſoon as the *flame* is broke forth from them; yet there may be ſo great a quantity of *Brimſtone*, and *Bitumen* or *Jews-lime* carried up from the *Bowels* towards the top of the *Mountain*, as may furniſh ſufficient Matter for a long continued *burning*. And as for thoſe Steams which are afterwards gather'd again in theſe *Cavities*, and kindled, they eaſily afterwards make their way by the paſſage that is already open'd for them.

XIV. *Why theſe Flames break forth from Mountains only at certain times and ſeaſons.*

Burning Mountains, after ſome time ceaſe to caſt forth *Flame* and *Smoak*, and after this Ceſſation return to the ſame task again.

The Reaſon is, becauſe that when the Sides of theſe *Mountains* are burſt open, *Water* comes flowing in to the ſaid *Cavities*, and ſtops up the Paſſages to them, ſo as that the Matter of *Exhalations* cannot ſo quickly be gather'd there again, and afford *Matter* to ſucceeding *flames*. It alſo very frequently happens, that by means of this vehement eruption of *flames*, the *parts* of the *Mountain* are overthrown, and fall down into the bottom of the Deep, from whence the *fire* did proceed; and the way for the *Exhalations* to break forth at, being thus ſtopt up, no further *Burnings* can be expected, till a freſh quantity of *Brimſtone* and *Jews-lime* be gathered and kindled, which by its breaking forth may open thoſe ſtopt Paſſages again, by caſting up that which obſtructed them. And this is the Reaſon why theſe *Fire-vomiting-Mountains* do not always retain the ſame Bigneſs: For *Veſuvius*, in Ancient Times, was of far greater bulk than now it is, and is ſcarcely an *Italian* Mile high, all its windings and turnings reckon'd in.

Nor will ſcorcht Ætna *ever vomit Flame,*
Since from beginning 't did not do the ſame.

Ovid. XV. *Metamorph.*

XV. *Why upon an approaching Earthquake VVell-water becomes troubled.*

When an *Earthquake* is near, the *Water* of *Wells* becomes troubled and muddy, and ſends forth a *ſtinking ſmell*.

This Effect is produced by the *ſteam* proceeding from the *Subterraneous fire*, which like a *ſmoak* breaking forth from a piece of *Wood* that is not throughly kindled, inſinuates it ſelf into the narrow *pores* of the *Earth*, and mingles it ſelf with the ſaid *Well-waters*. The ſaid *waters* do likewiſe ſend forth a *Noiſom ſmell*, becauſe this *ſteam*, which ariſeth from the *Bowels* of the *Earth*, proceeds from *ſulphureous* and *bituminous Bodies*, wherewith the inward parts of the *Earth* do abound; which being of a ſtrong and unpleaſant *ſmell*, no wonder if their *ſteams* communicate a like *odour* to the *waters*.

CHAP. IX.

Of Aſhes and Coals.

I. *VVhy Aſhes are called Snow.*

Aſhes, or that *light powder* which remains after that the *flame* hath conſumed all its *fewel*, in *Combuſtible Bodies*, are by *Chymiſts* compared unto *Snow*, and they commonly call it the *Snow of the Earth*.

Becauſe, as *Snow* doth conſiſt of moſt ſmall *Drops*, which by means of a *ſubtil Vapour* are woven or entangled together into *flocks*; ſo in *Aſhes*, the ſmalleſt *particles* of the *Earth*, by a ſubtil interweaving of *filaments*, are joyned together in leſſer *flocks*, which may be diſcerned by the help of a *Microſcope*.

II. *How it comes to paſs, that a Veſſel, full of Aſhes, contains almoſt as much water, as another Veſſel of the ſame bigneſs that is Empty.*

Aſhes ſoak up ſo much *Water*, that a *Veſſel* fill'd with them doth very near contain as much *Water*, as another empty *Veſſel* of the ſame bigneſs.

The Reaſon is, becauſe the *Pores* that are intercepted between the parts of the *Aſhes*, are like ſo many *flocks*, that take in the *Liquor* poured upon them. And they are perceived to have *little Bodies*, like to *caſt Skins* that ſuck in the *water*, and hide the ſame within their thin *ſurfaces*. But yet we muſt not from hence conclude with the *Peripateticks*, that there is the ſame quantity of *water* in a *Veſſel* fill'd with *Aſhes*, as there is in an empty one, ſeeing that the *Aſhes* can ſcarcely imbibe a 5*th* part.

III. *VVhy Aſhes are of uſe for the cleanſing of Linnen and VVoollen.*

Aſhes are of great uſe for the ſcouring and waſhing clean of *Bodies*. And therefore thoſe who take the *ſpots* of *Oil*, or any other *greaſy Matter* out of *Bodies*, do make great uſe of *Aſhes*, by means whereof they reſtore things to their former cleanneſs and neatneſs.

The Reaſon of this Effect is, becauſe *Bodies* are made ſmooth by rubbing againſt one another, and loſe all their Roughneſs: And therefore by the *rubbing* of *Bodies* with *Aſhes*, all the dirt and the filth that ſticks to them is waſht away with help of *Water*, which is that Vehicle, whereby the *Aſhes* are carried into the moſt intimate retreats of the *Body*, where the filth or ſtains do lurk; for having ſome part both of *fatneſs* and *ſharpneſs*, they become entangled with them, and by rubbing fetch out whatſoever Unevenneſs remains in the *Cloth*. And thus by the mixture of *Aſhes* and *Water*, a *Lye* is made, whilſt the *water* being as it were ſtrained through the *pores* of the *Aſhes*, and taking along with it their *ſharpneſs* and *fatneſs*, it is made very efficacious for the *waſhing* and *cleanſing* of things, from thoſe *ſtains* and *ſpots* that ſtick to them.

IV. *The Aſhes of Fig-trees very proper for the waſhing out of Spots.*

Hence it is obſerved, that the *Aſhes* of *Fig-trees* have a peculiar virtue for the *Cleanſing* of *Bodies* from *filth* and *ſtains*; becauſe the *leaves* and *wood*, whereof they conſiſt, do abound with *fatneſs* and *ſharpneſs*, or *acrimony*, which entring into the inmoſt parts of *Bodies*, do carry the filth along with them. And it is for the ſame Reaſon, that theſe *Aſhes* are found to be a good Remedy to ſtop the *Fluxes* of the *Belly*, and for the opening of *Obſtructions*, making the *Humors* to run freely through the *Body*, and through the *paſſages* appointed for them.

V. *Aſhes preſerve the Roots of Plants from the cold.* The *Roots* of *Plants* in *Winter* are covered with *Aſhes*, to preſerve them from being damaged by the *cold*, and that the *melted Snow* or *Ice* running down to them, may not hurt or injure them.

The Reaſon of this common uſe is, becauſe *Aſhes* are dry, and almoſt deſtitute of all manner of *Juice*, and therefore drink up the melted *Snow*, and hide it within their *Pores*. For *Aſhes* are hot, and are agitated with inteſtine *motions*. For as *Vinegar* and the *Lees of Wine*, do retain a warming *Virtue*; ſo *Aſhes* are partakers of a *Fiery quality*, and are endued with a *Virtue*, that reſiſts the effects of *cold*.

VI. *How Aſhes contribute towards the making of the Earth fruitful.* And for the ſame Reaſon it is, that *Aſhes* conduce to make the ground *fruitful*, becauſe of the *Salt* that is in them. For the *Fatneſs* of the *Earth* is lodged in *Salt* and *Nitre*, which being reſolved by *moiſture*, and heated by the *Sun*, doth ferment, and yields new productions. And therefore thoſe *Aſhes* whence the *Salt* hath been extracted, are of no uſe for this purpoſe, which may be provod by this *Experiment*: Dig a quantity of *Earth* deep out of the *Ground*, and having divided it into 2 parts expoſe them to the *Air*, the one in the ſame Condition as it came out of the *Ground*, and the other waſht ſeveral times by pouring *water* upon it, and ſuffering the ſame to run through it: And you ſhall find, that this *latter* will produce nothing, whereas the other will bring forth *Herbs*, *Worms* and little *Pebbles* within ſome ſhort time after.

VII. *Why Coals are of a black colour.* *Coals* and all other aduſt things, as *Soot* and ſuch like are of a *black colour*.

The Reaſon is, becauſe there are more *Pores* in *Coals*, and alſo in the burnt parts of *Animals* and *Vegetables*, than there were in the ſame Subjects before the *Fire* had touched them, and which may be ſeen in *Charcoal*, by means of a *Microſcope*. Now this multiplicity of *Pores* ſwallows up the *Light*, and hinders it from being reflected to the *Eye*. And from the multiplicity and largeneſs of theſe *Pores*, remaining in ſtead of the groſſer matter, that hath been turned into *Smoak* and *Steam*, the *Lightneſs* of *Charcoal* doth proceed.

VIII. *Why Coals keep Fire a great while.* *Coals* do preſerve *Fire* a good while, eſpecially if they be covered with *Aſhes*, and ſo kept from the *Air* coming to them.

The Reaſon is, becauſe the *Fire* which lies hid in the *Coals*, is lodged in ſome thin and branchy *Particles*, which being intangled with others that are thicker, tho' they be moſt ſwiftly agitated, yet can only get out ſucceſſively, that is, one after another. The *Fire* that is hid within the *Pores* of any *Body*, doth ſtand in need of ſome time, to have all its *Particles* diſſolved, that by this means it may extricate it ſelf from them; and probably before they can get thus free, the parts of the *Coal* muſt be worn and waſted by a long motion, and every one of them be ſubdivided into other parts again. But as long as the *Air* hath free acceſs to *Glowing Coals*, they are much ſooner conſumed, becauſe the *Air* doth by its motion blow away the *Aſhes*, and entring into the *Pores* of the *Coal*, dilates them more than ordinary, and ſo makes way for the *Fiery Particles* to fly away.

IX. *How Wood is turned into Charcoal, and how into Smoak and Aſhes.* Thus a piece of *Wood* being put into a *Veſſel* and covered with *Sand*, within a ſhort time after that *Fire* hath been put under the ſaid *Veſſel*, the *Wood* becomes turned into *Charcoal*, if ſo be the *Veſſel* cover'd with *Sand* be not preſently removed from the *Fire*, but ſo ordered that it may cool by degrees, nor too ſuddainly loſe all its *heat*. For if as ſoon as the *Veſſel* is taken from the *Fire*, the *Sand* be removed, the *Wood* upon the letting in of the *Air*, will preſently begin to *Flame*, and be wholly reſolved into *Aſhes*. Becauſe the *Branchy Particles* of the *Wood*, become by this means ſeparated from each other, and upon the removing of that which hindred, are diſſipated in the *Air*.

X. *A Live Coal being ſprinkled with water, grows the hotter.* If a little *water* be ſprinkled upon a *live Coal*, the *heat* is thereby encreaſed.

Becauſe the *moiſture* by entring into the *Pores* of the kindled *Body*, doth drive the *Particles* of the *Fire* into the inmoſt parts of it, and becomes mingled with them, but being forced to return by reaſon of the predominating *heat*, it carries the *Particles* of *Fire*, which lay hid in the *Pores* along with it, to the extream parts of the *Body*. And the ſame is the reaſon, why *water* which extinguiſheth ſmall *Fires*, yet by the fatneſs which it contains doth make great *Fires* burn more fiercely, becauſe by the motion of its flexible parts, it carries forth the *heat*, and raiſeth the *flame* to a greater height.

XI. *Why Charcoal enters the compoſition of Gunpowder.* In the making of *Gunpowder*, *Charcoal-duſt* is mixed with *Brimſtone* and *Nitre*, and being moiſtned with ſome *Liquor*, this Compoſition is formed into ſmall *Grains*, which of all other matter do moſt readily kindle and take *Fire*.

The Reaſon why *Charcoal-duſt* is made an ingredient of *Gunpowder* is, becauſe it abounds with *Pores*, and therefore is moſt eaſily penetrable. And no wonder that *Charcoal* is very *porous*, ſeeing that before the *Fire* had wrought upon it, the *wood* it ſelf had many little paſſages, which afterwards by the operation of the *Fire*, and the evaporation of ſo many *Particles* in *Smoak* and *Steam*, were mnch encreaſed: To which may be added, that *Charcoal* chiefly conſiſts of 2 kind of parts, whereof the one are *Thin* and *Branchy*, which as ſoon as they come near the *Fire* are eaſily kindled; as having already been agitated by the force of the *Fire*, but yet continuing entangled together by their ſlender and manifold *Branches*, which alſo would have made their eſcape, if the quenching of the *Fire*, had not ſtopt their flight. The other parts contained in *Charcoal* are *thicker*, which if the *Fire* had acted longer upon them, would have been turned into *Aſhes*. So that in this Compoſition of *Gunpowder*, the *Branchy Particles* of the *Brimſtone*, and the ſharp *Needles* of the *Nitre*, penetrating into the large *Pores* of the *Charcoal*, become entangled with its *Branchy parts* and cloſely drawn together, eſpecially by that time they are dried, after that the whole *mixture*, by the addition of ſome *moiſture*, hath been formed into ſmall *Grains*. This *compoſition* becomes kindled in this manner; Firſt, the *Fire* being applied, immediately kindles the *Brimſtone*, and at the ſame time puts the *Particles* of *Nitre* into motion, which thereupon requiring a greater ſpace wherein to take their turns, do rend the Bands of the *Charcoal*, and reſolve the *Grain* into *Flame* and *Smoak*. For the reſiſtence of the *Charcoal* doth greatly promote that ſwiftneſs, whereby the whirled Needles of the *Nitre* do break forth into a ſuddain *Flame*.

Aſhes

XII. *Why Aſhes are white.* *Aſhes* are commonly of a *whitiſh colour*, which grows much darker when *water* is caſt upon them.

Aſhes are *white*, becauſe the *Particles* which conſtitute them, are *Sphærical*; which our *Touch* can convince us of, foraſmuch as they feel ſmooth without any roughneſs at all: And conſequently reflecting the light on all ſides, they exhibit a *white colour*; which becomes darker upon the affuſion of *water*, becauſe moiſture, *as has been ſaid*, promotes *blackneſs*.

XIII. *How Wheat comes to grow from the Aſhes of it.* *Credible Authors* anſwer us, that *Wheat* hath ſprung from the *Aſhes* of it Sown in the Gound.

The Reaſon is, becauſe the *Salt* which remains in the *Aſhes* is a ſolid ſubſtance, and contains a great portion of *Earth*, and conſequently is moſt proper for the generation of *Plants*, ſince it cannot eaſily be exhaled, and becomes reſolved by the force of *Heat*. Wherefore theſe rudiments of the *Plants* remaining in the *Aſhes*, being diſſolved by ſome convenient moiſture, and the warmth of the *Air*, ſpring forth into a new *Plant*. Thus *Hogs-dung* produceth *Sowthiſtles*, and that becauſe it is common for theſe *Animals*, to feed upon them; for the *Seed* of *Sowthiſtles* remaining in the *Dung*, and reſolved by *heat* and *moiſture*, produce other *Plants* of the ſame nature.

XIV. *The Aſhes of a Plant contain the principles of a new Plant.* Hence it is that if we put the *Aſhes* of any *Plant* into a *Veſſel* with *water*, and expoſe the ſame to the *Air* in the *Winter-time*, as ſoon as the *water* is frozen, the reſemblance of the *Plant* will be expreſt on the *Ice*, at leaſt the *Leaves* of it. Which is a pregnant Argument, that in the *Aſhes* there remains a *Principle* of a new *Life*.

CHAP. X.

Of Glaſs.

I. *What Aſhes are moſt proper for the making of Glaſs.* THE moſt proper *Aſhes* that are known, for the making of *Glaſs*, are thoſe of the *Herb Kali*, and *Fern*.

Tho' the parts of *Aſhes* be very groſs and irregular, and cannot, tho' they lean one upon another, ſo unite together, as to compoſe a hard *Body*, becauſe the *Air* which fills the *Pores* that are left between them, doth hinder their Reſt; yet the *Aſhes* of the *Herb Kali* and *Fern*, are therefore the moſt proper of all others for the making of *Glaſs*, becauſe they abound with abundance of fixt *Salts*, which are very porous and ſpungy; ſo that when theſe *Aſhes* are put into a violent *Fire*, their *corners* are conſumed by it, and by this means the *ſurface* of their parts is made ſo ſmooth and even, that they touch in more Points than they did before, and afford a free paſſage to the *Beams* of *Light*, and cannot be rendred dark or opake without the mixture of ſome Forrein *Matter*.

II. *Why Glaſs is Tranſparent.* *Glaſs* notwithſtanding that it is a hard *Body*, and made up of the thick and irregular *Particles* of *Aſhes*, yet doth conſtitute Tranſparent and Light-ſome *Body*.

The cauſe of this perſpicuity of *Glaſs*, may be eaſily gathered from the make of it. For whilſt the *matter* of it, was by the violence of the *Fire* reduced to a *liquid form*, and all its *Particles* in agitation, the *Fire* flowing round about them, hollowed many *Cavities* in them, which the 2*d Element* freely entring, diffuſed the action of *Light* to all parts, in *right Lines*. And foraſmuch as the ſaid *Pores*, are after the *Glaſs* is made, continually preſerved and kept open, by the inceſſant paſſage of the *ſubtil matter*, and are filled as before, they cannot but tranſmit the *Light* as foremerly, ſo that the ſame tranſparency which was in the molten and *liquid Glaſs*, remains in the cold and hardned. For this is a thing common to all *Bodies* that are melted in the *Fire*, that whilſt they are yet in that *liquid form*, their parts do eaſily accommodate themſelves to any *Figure*, which they retain after that they are grown cold. If at any time any darkneſs be perceived in *Glaſs*, that proceeds from ſome *Dregs*, *Clouds* or *Bubbles* that are mingled in its texture, which ſince they are much more numerous in thick *Glaſs* than in thin, therefore we muſt impute the darkneſs of thick *Glaſs* to them.

III *Why Glaſs is Brittle.* *Glaſs* is very *Brittle*, and will not ſuffer it ſelf to be extended, but upon the leaſt ſtroak breaks to ſhivers,

The Reaſon is, becauſe tho' *Glaſs* be a hard *Body*, and does conſiſt of parts that are thick enough, yet foraſmuch as the *ſurfaces* by which they touch one another, are very ſmall, ſo that they joyn only in *Points*, for this reaſon it is, that if they be never ſo little ſeparated from each other, they loſe their *union* and fly into bits. Whereas many ſoft *Bodies* are much harder to be broken, becauſe they have their parts ſo intangled, that they cannot be ſeparated, without the breaking of many of thoſe *Branches*, by which they were held together.

IV. *Glaſs ſometimes breaks of it ſelf.* It is a thing known by long experience, that *Glaſſes* after they have laſted a long time, do at laſt break of themſelves. More particularly this is notorious to them, who grind thoſe *Glaſſes* that are uſed in *Proſpective Glaſſes*; for they find that after they have been poliſhed a long time, they ſlit of themſelves. The cauſe whereof is, becauſe the *Saline Particles*, being agitated by the *ſubtil Matter*, do endeavour to break looſe: As may be gathered from hence, that in the *Winter ſeaſon*, and *Rainy weather*, ſomething may be wiped from *Glaſſes*, that hath a *Saltiſh taſte*. And not long ſince there was a certain man at *Amſterdam*, who broke *Rheniſh-wine Glaſſes* only with his *Voice*, and that not very ſtrong neither, but tuned to a certain *Pitch*.

V. *Why Glaſs that is newly taken out of the Furnace doth break when expoſed to the Air.* A *Glaſs* newly taken out of the *Furnace*, if it be expoſed to the *cold Air* breaks immediately; and ſo likewiſe if any *water* be caſt upon it.

The Reaſon is, becauſe when the *cold* doth draw together and narrow the *Pores* of the *Glaſs*, the *ſubtil Matter* and the *fiery Particles* are by this means lockt up in them: And whilſt the former of theſe preſs to make their way through the *Pores* of the *Glaſs*, and the others endeavour to get out from it, they by ſtriving to widen the *Pores*, make the *Glaſs* to fly in pieces.

VI. *A cold Glaſs held to near the Fire cracks.* If a *cold Glaſs* be held ſo near to the *Fire*, that it heat in one part more than in another, it preſently breaks.

The Reaſon is, becauſe when the *Fire* is got in to the *Glaſs*, the *Pores* of it are not all equally dilated by it, and therefore when the *ſubtil matter* gets into them, ſeeing the *Pores* where the *Glaſs* is *cold*, are not wide enough for its free paſſage, it makes way for it ſelf by rending the *Glaſs* to pieces.

pieces. But if it be by degrees, and by little and little held to the *fire*, it will ſuffer no hurt at all; becauſe all its *pores* will by this means be ſufficiently dilated, ſo as to afford a free and open paſſage for the *ſubtil matter*. And therefore when *Glaſſes* that have contained any *hot Liquor*, are ſuddainly emptied and expoſed to the *Air*, they crack immediately; becauſe the *ſubtil matter*, which is pent up in the *pores* of *Glaſs Veſſels*, ſtriving to get out, finds no way for it ſelf, becauſe the *pores* are conſtringed by the coldneſs of the *Air*; and therefore makes its way by breaking the brittle ſides of the *Glaſs*.

VII. *How the breaking of Glaſſes may be prevented.*

To avoid this *breaking* of *Glaſſes*, they that belong to the *Glaſs-houſes*, take the *Glaſſes* that are newly *blown*, and ſet them in a place at ſome diſtance from the *fire* to Neal, as they call it, removing them every 6 hours, the diſtance of 8 or 10 Foot, before they expoſe them to the *Air*; by which means all the parts of the *Glaſs* being inſenſibly and equally *cool'd*, there is an equal conſtriction of the *Pores*, ſo as that the *ſubtil matter* which can paſs one of them, can with like eaſe paſs all the reſt.

VIII. *How Glaſs comes to have an Attractive Virtue.*

Glaſs ſeems to have ſomething of a *Magnetick Virtue*; for when it is ſtrongly rubb'd, ſo as to be heated thereby, it draws the neighbouring *Bodies* to it ſelf.

The Reaſon is, becauſe the agitated *particles* of the 1*ſt Element*, continually paſs from the *Glaſs* into the *Air*, and others from the *Air* return to the *Glaſs*, to take up the room of the former; and becauſe thoſe *particles* which return from the *Air*, have not all of them the ſame degree of *Agitation*, thoſe which have leſs, are driven towards the little *ſlits*; which have no correſpondent Pores in the *Air*, and being, as it were, heaped upon one another, do conſtitute certain *wreaths*, which in proceſs of time acquire determinate *Figures*, which afterwards are not eaſily changed. Wherefore when *Glaſs* is ſtrongly rubb'd, ſo as to grow *hot*, theſe wreathed *particles* being driven out, are diffuſed indeed through the neighbouring *Air*, and enter into the *pores* of *Bodies* that are about them: But foraſmuch as they do not there find an open and ready way for themſelves, they return to the *Glaſs* immediately, and carry along with them any little *Bodies* they meet with in their way.

IX. *Glaſs becomes variouſly coloured, by being mingled with Metals.*

When in the *melting* of *Glaſs*, a *Metal* is mix'd with it, the parts whereof cannot ſo eaſily be ſmoothed and poliſhed by the action of the *Fire*, as thoſe of the *Aſhes* are whereof the *Glaſs* is made, then the *Glaſs* becomes ting'd of divers *Colours*.

The Reaſon is, becauſe the metalline *particles*, which are very irregular, do inſinuate themſelves into the *pores* of the *Glaſs*; and by this means, make the parts of the 2*d Element*, that paſs through the ſame, to move and roll differently from what they did before, and conſequently to repreſent thoſe *Colours* which are cauſed by theſe their different rolings.

X. *What is the reaſon of the ſtiffneſs of Glaſs.*

Glaſs is very ſtiff, and cannot be bent without the danger of *Breaking*. Wherefore, if it be never ſo little bended one way, it preſently ſprings back like a *Bow*, and returns to its former *Figure*.

The Reaſon is, becauſe this bending doth ſome what change the *figure* of the *Glaſs*, and *ſtraitens* the *pores* of it; ſo that the *particles* of the 1*ſt Element*, that before paſt through them, finding their way not ſo eaſie as before, and yet purſuing their *motion* as far as they are able, force the ſides of them, and endeavour to reduce them to their former *figure*. For this property of *leaping back*, is not peculiar to *Glaſs* only, but to all *hard Bodies*, whoſe *particles* are joined by immediate contact, and not by the weaving or intangling of *Branchy parts*: As is evident in a bended *Bow of Steel* or *Wood*, which preſently leaps back to its former ſtate, except it have continued bent too long; and that the *ſubtil matter* hath found of made it ſelf other paſſages to run through.

XI. *Why Glaſs melts by the force of Fire.*

Glaſs is *melted* by the action of *fire*, and whilſt it is ſo, is eaſily formed into all ſorts of *figures*.

The Reaſon is, becauſe the parts of *Glaſs* having been before worn and poliſhed by the force of *fire*, are eaſily moved, and obliquely *creeping*, and flowing one upon another, they begin to touch each other in ſome ſmall part of their *ſurfaces*, and following one another, conſtitute a *fluid Body*, which may be formed into any *figures*, according to the pleaſure of the *Artiſt*. Moreover this *fluid Body*, as it grows Cold, becomes tough like *Birdlime*, ſo as that it may be drawn into thin *Threds*; becauſe as long as that motion is continued in it, whereby its *parts* do flow, lying *obliquely* upon one another, it may the more eaſily be drawn out into *Threds*, than it can be broken.

XII. *Glaſs beaten to Powder becomes a Poiſon.*

Glaſs beaten into *Powder*, according to the opinion of ſome *Phyſicians*, becomes *Poiſon*.

The Reaſon of this, as I ſuppoſe, may be, becauſe the pieces of *Glaſs* are hard and ſharp, which hurting and wounding the *Membrans* of the *Stomach* and *Guts*, as well as of the other ſmaller *veſſels*, become deſtructive to the *Body* of *Man*. For I do take *Glaſs*, when it is yet *whole*, to be no *Poiſon* at all; foraſmuch as many have ſwallowed it without any hurt; which is an argument, that all the hurt that can accrue to our *Bodies* from *Glaſs*, muſt proceed from the *hardneſs* and *figure* of its little *particles*.

CHAP. XI.

Of the Air.

I. *Why the Air is inſipid.*

THE *Air* is inſipid, and makes no impreſſion of *Taſte* upon the *Tongue*.

The Reaſon is, becauſe it *ſwims* upon our *Spittle*, and doth not mingle with it, and therefore cannot affect the *Nerves* of the *Tongue*. And hence alſo we may ſee the reaſon why *water* is inſipid; as likewiſe why *fat Liquors* are leſs diſcernible by their *taſte*, than *dry things*.

II. *Why the Air that is nearer to the Earth, is hotter than that which is further off.*

The *Region* of the *Air*, which is neareſt to the *Earth*, is found to be warmer than that above it, where *Cold* hath a greater dominion, and where *Hail*, *Snow*, and other cold *Bodies* are generated.

The Reaſon is, becauſe the *Rays* of the *Sun* being copiouſly reflected from the *Earth*, do agitate the parts of it more than ordinary. For a violent agitation of the parts of the *Earth* produceth *Heat*, eſpecially if it be cauſed by the *Light*, and do continue for ſome time. And foraſmuch as the *Rays* that are reflected from the *Earth*, are not in ſo great abundance carried up to the higher *Regions* of

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of the *Air*; and thoſe which get up thither, do communicate their motion all along to the *Bodies* they meet with, it cannot be, but that *cold* muſt ſucceed upon this diminiſhed agitation, and ſo give occaſion to the condenſation of *Clouds*, and the production of *Snow* and *Rain*.

III. *How the Air may be made more heavy.*

The *Air* being thruſt and crouded into any *veſſel*, does become more heavy, than that which is diffuſed in a free and open place. Which GALILÆUS made an Experiment of after this manner. *I took*, ſaith he, *a large Glaſs Bottle, and carefully applied to the Mouth of it the Neck of a Bagpipe, by which means I crouded into it a very great quantity of Air; for becauſe of its eaſie condenſation, 2 or 3 Bottles full of Air were thruſt into it over and above that which was in it at firſt.* Now by this Experiment *Galilæus* learnt, that the crouded Air had made the *Bottle* more heavy than before; and that as ſoon as the *Mouth* was unſtopt again, the weight of it was again diminiſhed.

The Reaſon is clear and evident; becauſe in the *condenſation* of *Bodies*, the parts come nearer together and are more intimately joyned; And therefore being in greater quantity, they cannot but weigh more than before; for a greater quantity of *Air* makes the *Veſſel* more *heavy* than a leſs quantity. As will be evident, if this *Bottle* with *Air* be fitted to another *Bottle* full of *Water*, with a *hole* at the bottom of it, which may be opened at pleaſure: For when the *Bottles* are thus joined together, and a paſſage left open for the *Air* to enter into the *Bottle* full of *Water*, as much *Water* will run out as there was of condenſed *Air* that was crouded into the other *Bottle*. And therefore we are to ſuppoſe, that the quantity of *Air*, that was with force driven into the *Bottle*, is equal to the quantity of *Water*, that was driven out from it through the *Bottle*.

IV. *How much the Water is Heavier than the Air.*

It ſeems to be difficult to determine how much the *Water* is heavier than the *Air*; foraſmuch as the weight of the *Air* is not the ſame in all places. Yet may the ſame be, in ſome ſort, determined from a late *Experiment*; by which, well-nigh, all the *Air* having been contracted out of the great *Glaſs Veſſel* of the *Pneumatick Engin*, and the Mouth of it ſtopt, it was laid in a *Scale*, to know exactly how much the *Veſſel* weighed without *Air*; and afterwards when the *Air* was let in again, it was weighed a 2*d* time, and then found that the *Veſſel* weighed about an *ounce* and half more than it did before: So that according to this *Experiment* the *Water* ſhould ſeem to be almoſt 1000 times heavier than the *Air*.

V. *A Deſcription of the Pneumatick Engin.*

For the further clearing of this, and the following *Phænomena*, I think it will not be uſeleſs to give here a deſcription of the foreſaid *Engin* or *Machin*. It conſiſts chiefly of 2 parts, *viz.* of a *Syringe* or *Pump*, and a Glaſs Veſſel, which is called a *Recipient*, whence the *Air* is pumped. Between the *Syringe* and the *Recipient* is a *Copper Pipe*, through which the *Air* paſſeth out of the *Recipient* into the *Syringe*; and in the *Pipe* is a *Peg*, by the turning of which the *Air* is either ſuffered to paſs out of the *Glaſs* into the *Syringe*, or ſtopt from paſſing. When therefore the *Sucker* is pulled up, the lower part of the *Syringe* is ſtopt with ones *Finger*, that the *Air* may paſs out of the *Recipient* into the *Syringe*; and when the *Sucker* is preſt down, then by turning of the *Peg* the *Air* is hindred from paſſing out of the *Recipient* into the *Pump*; and by removing ones *Finger*, the *Air* is driven out of the lower end of the *Syringe*; the reſt will be eaſily perceived by the *Eye*, or underſtood from the Figure. A is the *Pump*, at the bottom whereof B is a little *hole*, which is ſhut with ones *Finger*, when the *Sucker* is drawn up, by means of the Handle belonging to the indented *Wheel*, and of a plate of *Iron* alſo indented, which is faſtned to the *Sucker*. When the *Sucker* is drawn up, the *Air* ruſheth forth out of the *Recipient* F, through the *Pipe* I, into the *Pump*: For then by turning the *Peg* L, the *Air* hath an open paſſage afforded it into the *Syringe*; but when the *Sucker* is thruſt downwards, and the *Peg* turned the contrary way, the *Air* is ſtopt from returning into the *Recipient*; and then upon taking away ones *Finger* B, the *Air* is thruſt out through B, and the *Recipient*, by degrees, is emptied: And this pumping muſt be reiterated ſo long, until the *Recipient* F be emptied of all the *Air* that was in it. Having thus ſet down the Frame of this *Engine*, we will proceed to ſome Experiments that are made by it. Figure 20.

VI. *According as the Air is either exhauſted or let in, ſo the Stopple of it is either more hardly, or more eaſily removed.*

1ſt. After that the greateſt part of the *Air*, contained in this *Engin*, is evacuated, the Stopple which ſhuts the upper *Mouth* of it, cannot without difficulty be removed, as being preſt down with a greater weight; but is moſt eaſily removed, when by turning of the *Peg* the *Air* is let in again; for when that Hole is ſhut, the outward *Air* doth more ſtrongly preſs the *Engin*, than when it is open.

VII. *The ſame effect happens to the Plug.*

2*dly*. Upon the ſame *Evacuation*, the *Sucker* is very difficultly drawn upwards; but being drawn up, doth of it ſelf run down again, tho' an 100 pound weight were faſtned to it; becauſe upon the exhauſting of the ſhut up *Air*, which before ballanced the outward *Air*, this being now become more heavy, forceth the *Sucker* to enter into the *Pneumatick Pipe*, ſo as that being, as it were, bound with ſtrong Bonds, it cannot be ſeparated.

VIII. *A Square Glaſs Bottle breaks upon the evacuation of the Air.*

3*dly*. A *Square Glaſs Bottle*, tho' it be of thick *Glaſs*, upon the evacuation of the *Air*, breaks immediately; whereas a round *Glaſs*, tho' it have a crack in it already, doth not only not break, but alſo keeps the external *Air* from entring into it; becauſe, by how much the *External Air* doth more preſs the parts of the *Glaſs*, the more they do mutually ſupport each other, as we ſee it is in arched *Roofs*, ſo that none of them can give way: But the caſe is different in a *Square Bottle*, which hath much leſs force to reſiſt, as being unable to withdraw the force and weight of the External *Air*.

IX. *A Bladder, upon the evacuation of the Air, ſwells in the Pneumatick Engin.*

Hence it is, that if you tie the neck of a *Bladder*, after that you have ſqueezed the *Air* out of it, and ſo put it into the *Glaſs Recipient*, upon the Evacuation of the *Air*, that was in the *Recipient*, you will find the *Bladder* begin to ſwell, and to that degree, that ſometimes it burſts, with a great noiſe. The ſame thing may be ſeen in the common *Torricellian* Experiment: For if you put the Bladder of a *Carp*, almoſt void of *Air*, into the *Pipe*, it is preſently blown up, becauſe the remaining parts of the Air, being looſened by the neighbouring Air in the Pipe do extricate themſelves. And therefore as ſoon as the Air is let in again into the Recipient, or into the Pipe, the ſwoln *Bladder*

immediately falls again. The same thing also happens when the parts of the *Air* are agitated by *Heat*; for we see that a *Bladder*, which is not above half full of *Air*, if it be laid near the *Fire*, is blown up to the utmost, and becomes very hard.

X. *Aqua Fortis and Vinegar do swell in the Pneumatick Engin.*

Aqua Fortis, in which a *Metal* hath been dissolved, and *Vinegar* impregnated with the solution of *Coral*, do wonderfully swell in the *Recipient*, upon the extraction of the *Air*, and seem to *boil*; because the *Particles* of the *Air*, that are shut up in the *pores* of these *Liquors*, being set at liberty by the pression of the Ambient *Air*, do diffuse themselves into a larger space. And so likewise it hath been observed, that if a *shrivel'd Apple*, be put into the *Recipient*, after that the *Air* is drawn out, it becomes plump up again, and looks as fresh, as if it had been but newly pluck'd from the *Tree*; and if the *Skin* of it be broke, a kind of a froth breaks forth from it, as if it were roasted at the *Fire*.

XI. *How Bullets are discharged from Wind-Guns by the compression of the Air.*

The *Air* when shut up in any *Vessel*, and compress by outward force, becomes endowed with a power to leap back or rebound, as is evident in *Wind Guns*, from which leaden *Bullets* are discharged with so great force, as they seem to exceed the force of those that are discharged by *Gunpowder*. So likewise there are many other *Engins*, which by compressing of the *Air* only, cast up *waters* to a great height.

The Reason is, for that when the *Air* is compress within these *Pipes* or *Engins*, every one of its *particles* cannot enjoy that round space it stands in need of, to turn round about its own *Center*; but other neighbouring *particles* encroach upon it. And seeing that the same force of heat, or the same *agitation* of the said *Particles*, is preserved by the motion of the *Heavenly Globuli*, and that they cannot freely display themselves, being hindred by their neighbours pressing in upon them, they hit and push one another with their Corners, driving each other out of their places. And thus with united forces strive to recover their former liberty, and a larger space to move in.

XII. *What is the reason of the sudain and violent eruption of fermented Liquors out of the Bottles, wherein they have been pent up.*

In like manner small *Wines*, and new *Beer* or *Ale*, being put up into *Bottles*, break forth, as soon as they are opened with a great force; because the parts of the *Tartar* or *Wine-Lees*, being pent up within the sides of the *Bottles*, cannot be separated, or flee from one another; and therefore by means of their intestine agitation, do so cut and divide one another, that tho' they be mixed, yet there is no connexion between them; which is the Cause, that as soon as the *Bottle* is unstop'd, they break forth with great noise and violence, in the form of *froth*.

XIII. *Why a Blader that is blown up, being struck against the ground, doth rebound again.*

Thus also blown up *Bladders*, being struck against the *Ground*, do rebound again: for the *Air* being compress in the *Bladder*, is agitated by the *subtil matter*, which is lodg'd between the parts of it; and striving to recover its former freedom, lifts up the *Bladder*; and being unable to bear any greater compression, beats back the hard *Bodies* it meets with. The same *Elastick Force* is clearly demonstrated, by putting a *Swines Bladder*, distended with *Air*, into the *Pneumatick Engin*; which upon the evacuation the *Air*, doth ordinarily distend it self to bursting: Sometimes lifts up 50 pound weight, because the shut up *Air* being delivered from the weight of the *External Air*, doth endeavour a greater dilatation, and by extricating it self, takes up a greater place.

XIV. *Why the water is prest downwards in a Weather-Glass, in hot weather.*

Accordingly also a reason may be given of the descent of the *water* in a *Weather-glass*, when it is hot: For the *Air* that is contained in the *Glass*, being agitated by stronger *Beams* of the *Sun*, or with more *Heavenly Matter*, doth dilate it self, and consequently bears down the *water*; which cause is no sooner removed, and the dilatation diminished, but the *water* riseth again as before.

XV. *How it comes to pass, that a weak brittle Glass can resist this Elastick force of the Air.*

But you'l say, if the *Air* be endued with an *Elastick Force*, how comes it to pass, that when it is shut up in thin *Glass Bubbles* or *Drops*, *Hermetically Sealed*, it doth not break through the thin *Walls* of its *Prison*?

I Answer, that these weak *Bubbles* are not broken; because as the *Glass* is prest by the inward *Air*, so in like manner the outward *Air* dasheth against the said *Glass*, and because the force is on both sides equal, it cannot break the *Glass*. For the same reason it is, that *Bubbles swimming* on the *water*, continue whole for a considerable time without breaking; and so making way for the pent up *Air* to get out. Which could never be, without the pression of the *Ambient Air*; forasmuch as the *Air*, by its *Elastick Force*, is able to break very thick *Glass* to pieces.

XVI. *How the Heaviness of the Air may be proved.*

Take a *Glass Pipe* 3 foot long, having one end of it stopt up, and the other open, and fill it with *Quicksilver* to the top, then turn it with the open end of it downwards into a *Vessel* likewise full of *Quicksilver*, so that it may run down into the *Vessel*. And you will find that the *Quicksilver* will not descend to the Bottom of the *Pipe*, but will continue 27 *Fingers* breadths high, or thereabouts.

The *weight* of the *Air* is the cause which keeps the *Quicksilver* at the height, and doth not suffer it to sink lower. For tho' the *Quicksilver* that is in the *Pipe* be very heavy, yet can it not run down into the *Vessel* that lies under it, without raising the *Quicksilver* that is in it, and consequently the whole *Mass* of the *Air* that lies above it. Now the thick and agitated parts of the *Air*, do hinder its further condensation, because it is not without reluctance that they suffer any compression, and are reduced to a more narrow space and compass. But yet we must not imagine that every *Air* hath a like force to resist, but that the same varies according to the degrees of its *Rarity* or *Density*, that is, its looseness or compactness: For a *loose* and *thin Air*, and whose parts are more weakly dilated by *Heat*, is more easily bent, and doth less resist the pressure of the *Quicksilver*, than that *Air* which is more *thick*, and the *Particles* whereof are more vehemently expanded. And for this reason it is that the *Quicksilver* sinks lower in *Fair*, than in *Cloudy* and *Rainy Weather*, and that the *Air* which is on the *top of Mountains*, doth less oppose the driving of the *Quicksilver*, than in a *Valley* or shady place; because in this latter place the *Air* is thicker, and more weakly agitated by the heat of the *Sun*. Wherefore it is evident that the *Quicksilver* contained in the *Pipe*, is kept up by the weight of the *Air*, and that it would sink till it came to be level with that which is in the

the *Veſſel*, in caſe it were not hindred by the weight of the *Air* that lies upon it.

XVII. *The Quickſilver in a Weather-Glaſs is variouſly raiſed, according to the Change of the weather.*

Thus we experience, that when the *North-wind* blows, and it is *Fair-weather*, the *Quickſilver* riſeth higher, and ſometimes to 28 *fingers* breadths; whereas when the *South-wind* blows, and in *Rainy-weather*, the *Air* is much lighter, and the *Quickſilver* only riſeth to 27 *fingers* breadths. Thus alſo by the means of *Pumps*, the higher that the *Quickſilver* is in the *Barometrum*, or Inſtrument to diſtinguiſh the weight of things, the higher the *water* riſeth, that is, 32 *foot* high, when the *North-wind* blows; but during a *South* or *Weſt-wind*, and in *Rainy-weather*, ſcarcely 31 *foot* high, and ſo much the leſs as the *Pump* is placed on higher ground.

XVIII. *The Contact or Connexion of Bodies is cauſed by the Heavineſs of the Air.*

The mutual *contact* of *Bodies*, whence they derive their firmneſs and connexion, is a pregnant Evidence of the weight of the *Air*: For we find, that 2 Marble *Poliſht Bodies*, beſmear'd with *Oil*, do ſometimes ſo cloſely ſtick together, that a cloſer Connexion can ſcarcely be apprehended. But no ſooner are theſe 2 *Bodies* put into the *Pneumatick Engin*, but immediately, upon the evacuation of the *Air*, the piece of *Marble* that lies undermoſt, is immediately ſeparated from the upper; becauſe the *Air*, that lies under the Lower *Marble*, doth no longer bear it up, and is no longer able to keep it cloſe joyned with the upper.

XIX. *How it comes to paſs, that ſometimes 2 Marbles ſtick cloſe together in a place that is void of Air.*

And if at any time it happen, that 2 *Marbles* ſtick cloſe together in a *vacuum*, the Cauſe is only this, becauſe the *ſubtil Air*, which pierceth through the ſides of the *Glaſs*, doth not find any entrance between 2 exactly poliſht *Marbles*: And therefore the lower Marble cannot fall down without preſſing and raiſing the foreſaid Subſtance, which reſiſts more than it can be preſſed by the *Body* that lies upon it. But when *Marbles* are anointed with *Oil* or *Spirit of Wine*, that by means thereof they may be the more cloſely glewed together, then, as ſoon as the *Thicker part* of the *Air* is drawn out of the *Recipient*, Aiery *Bubbles* do immediately ariſe from the ſaid *Oil* and *Spirit*; which *Bubbles* being afterwards dilated by the *Elaſtick virtue* of the *Æthereal ſubſtance*, do ſeparate the *Marbles*, that before ſtuck together.

XX. *Why a Bladder fill'd with Air doth ſink the ſlower, the nearer it comes to the bottom of the Water.*

Hence we may conclude, that a *Bladder* fill'd with *Air* requires the greater force to preſs it downwards, by how much the nearer it comes to the bottom of the *Water*; becauſe the *Air* riſeth the more ſlowly from the bottom of the *Water*, towards the *Region* of the *Air*, by much the nearer it approacheth to it. And the Reaſon is, becauſe fewer parts of *Water* do lye upon it, which by lifting up the *Bladder* or *Air* from beneath, puſh it upwards. Wherefore, if we ſhould ſuppoſe the *Flame* to mount up through the *Air*, quite to the Orb of the *Moon*, it would ſtill move ſlower and ſlower, the higher it aſcended; becauſe the *fire* doth not mount upwards by any virtue of its own, but is only driven upwards by the *Air* that ſurrounds it. For the Parts of the *Air* that are nearer to the *Earth*, being more compreſt by thoſe that lye upon them, they do with more force puſh forwards the *flame*, than when they are more remote from the *Earth*; where, becauſe they have fewer parts preſſing them downwards, they lye the looſer, and conſequently drive up the *flame* more faintly.

XXI. *By what means the Quickſilver is hindred from ſinking lower in the Glaſs-Pipe.*

If a *Glaſs-Pipe* that is not 27 *fingers* breadth long, after the manner as before explained, be filled with *Quickſilver*, it will not at all ſink down in it; but will continue fill'd to the top, without any ſubſidence.

The Reaſon is, becauſe the *particles* of the *External Air* are ſo agitated, and do ſo comply with the motions of the *Heavenly Globuli*, that they cannot be compreſt by the weight of the *Quickſilver*, that is, leſs than 27 *fingers* breadths high, and conſequently do ſo dull its force, as to hinder its deſcent.

XXII. *Why the Water in Pumps cannot riſe above 31 Foot high.*

The *Water* is raiſed in *Pumps* by the motion of the *Sucker*; but cannot be raiſed above 31 *foot* high.

The *Water* mounts up, together with the *Sucker*, when it is drawn upwards; becauſe there is no *Vacuum* in Nature, and all Spaces are fill'd with *Bodies*, ſo that there can be no motion, without a total Circulation of the *Bodies*, that are about the thing which is moved. And therefore it happens, that as ſoon as the *Sucker* is drawn up, it makes the *Air* that was above the *Pump*, to move about the midſt of it; and that which was about the midſt of it, to come into the place where the *water* is, which mounting upwards comes in the room of the *Sucker*. For the *Water* chiefly moves that way, where is the leaſt preſſure of *Air*, that is within the Bore of the *Pump*, which the *Sucker* hath left. Now the Reaſon why the *water*, by means of *Pumps*, cannot aſcend above 31 *foot*, is, becauſe the *Air*, by its natural *weight*, having driven up the *water* without condenſation, and being afterwards unable to bear a greater weight of *water*, is by the motion of the *Sucker* ſhaken with greater violence than ordinary, and by this means plyes and is broken; and becauſe the *ſubtil matter* is driven out above the *water* in the Bore of the *Pump*, the *water* ſettles at the due height of 31 *foot*.

XXIII. *How Sucking is performed.*

And it is for the ſame Reaſon that the *water* mounts up in a *Pipe*, upon the ſucking of it; for the *Air* by its weight preſſeth all the parts of the *Water*, or other *Liquor* that is in the *Veſſel*, in which one end of the *Quill* or *Pipe* is dipt, except only thoſe parts which are directly under the Lower-end of the *Quill*, which is oppoſite to the upper part of it, which is in the Mouth of him that ſucks: Whereupon, as ſoon as the *Muſcles* have lifted up the *Palat* and the *Breaſt*, the *Air* within dilates it ſelf, and being dilated, is not of ſtrength enough to hinder the *water* from entring the *Pipe*, into which the *external Air* drives it; whence it is, that when we ſuck through a *Pipe* of a certain length, it is all one as if the Mouth it ſelf were extended ſo far. And it is by the ſame Reaſon, that an *Infant*, by applying his *Mouth* round the *Nipple* of his Mothers *Breaſt*, draws the *Milk* from it.

XXIV. *Why a mans Hand ſtretched out in the Air, doth not perceive any weight.*

A *Hand* held forth in the midſt of the *Air*, feels no Heavineſs; tho' indeed the *Air* it ſelf be Heavy, and conſequently muſt needs preſs the *Hand*.

The Reaſon is, becauſe the *Hand* is preſt on every ſide by the *ambient Air*, and as much by that which is under it, as by that which lies upon it. For the *Air* which is under the *Hand*, is driven by

by the weight of the other parts of the *Air* that are on the sides of it. Like as the *water* which answers to the bottom of a *fraighted Ship*, is driven towards the bottom of the *Ship*, by the weight of the *water* that surrounds it at the top. Seeing therefore that the upper *Pillar of the Air* hath no more Power to drive the *Hand* downwards, than the lower hath to drive it upwards; it is no wonder that we are not sensible of any *weight*, when we reach our *Hand* out into the *Air*. Hence it is also, that when we lay our *Hand* upon the *Mouth* of a *Vessel*, whence the *Air* is extracted, it begins to swell.

XXV. *Why a Glass Vial breaks, when put into the Recipient of the Pneumatick Engin, after that the Air is exhausted.*

And the same Reason must be given why a *Glass Viol* being put into the *Recipient* of the *Pneumatick Engin*, after that the *Air* is pumped out of it, breaks to pieces; for seeing that there is no outward *Air* that might *repel* the force of the inward, and resist the force of its endeavouring to dilate it self, the *Air* which is within the *Viol*, bearing against the sides of the *Recipient*, hath the power to press and draw it together, and at last to break it to pieces.

XXVI. *Why the flesh swells upon the application of Cupping-Glasses.*

And for the same Reason it is, that when the *Air* is dilated by the Flame in *Cupping Glasses* that *Chyrurgeons* make use of, as soon as the *Fire* is extinguish'd, the *Flesh* that is contain'd within the *Cupping Glass*, begins presently to swell; because that part is less prest upon by the rarefied *Air*, than that which bears the weight of the outward *Air*. And this makes it appear, that the *Sucker* in the *Pneumatick Engin*, after that the *Air* hath been exhausted out of the *Syringe*, the under Orifice whereof is stopt, cannot be drawn up because of the weight of the *Air*. For the *Pillar* of *Air* which is of the same Bulk with the *Sucker*, must first be removed out of its place. But when this outward *Air* is extracted, then the *Sucker* is without any trouble at all drawn out of the *Syringe*, tho' the lower Orifice be stopt.

XXVII. *Why the water that is in a Glass, doth sometimes appear lower in the midst, and sometimes higher.*

The same Reason also must be assigned why *water*, that is in a *Glass* or *Cup* that is not filled to the brim, seems to be low in the midst, and more raised towards the *Edge*, as hath been already mentioned; for the middle part of the *water* is prest on every side, but not the extream or outside parts, upon which the *Air* exerts its force more weakly and obliquely. But on the contrary, when the *Glass* is fill'd to the top, the *water* swells in the midst. For besides that the *water* cleaves close to the sides of *Glass*, its middle parts are only compress by the *Air* that lies above it, whereas the outsides are prest every way; and the *Air* that lies under it, and is beneath the *Horizontal Line*, exerts its force upon that part of the *water* which toucheth the sides of the *Glass*; which makes the *water* strive to get thither, where the pressure is weakest.

XXVIII. *Why the Air grows lighter upon the approach of Stormy Weather.*

Before a *Shower* or *Storm*, the *Air* is not so heavy as it was before; and the same is when the *South-wind blows*, tho' no *Shower* follow.

The Reason of this seems to be, because the *Steams* or *Vapours* which arise out of the *Earth*, and which mingle themselves with the *Particles* of the *Air*, are precipitated, and condensed into *Clouds*: By which means the upper part of the *Air* becomes much dilated, and quitting those *Bodies* that mixed with it, becomes more thin and *subtil*. For there is no question to be made, but that the *Air* contains in it self many *parts* of *water*, from the Coagulation and Condensation whereof *Clouds* and *Showers* are formed. This appears in Mr. BOYLES *Pneumatick Engin*; for as soon as the *Air* enters the void *Recipient*, it appears, as if it were all covered with a Mist.

The

To the Worſhip-full Phillip-
Bickerſtaff of Chirton in the
County of Nor-thumberland Eſqr.

This Plate is humbly Dedicated by Richard Blome.

The Fifth Part
OF THE
HISTORY
OF
NATURE.
OF
Things dug out of the Earth.

CHAP. I.

Of Metals in General.

I. *Whence the variety of the Metals that are in the Earth doth arise.*

THE great use that *Metals* afford to the Life and Convenience of *Mankind*, may seem in some degree to excuse their *Covetousness*, who break up the *Bowels* of the *Earth* to come at them. For doth not *Gold* and *Silver* furnish us with *Mony*, *Rings*, *Jewels*, and a thousand *Ornaments* and *Utensils*, for our *Cloaths*, *Houses* and *Tables*? And who is ignorant of the absolute necessity of *Iron*, or of the great usefulness of *Tin*, *Lead* and *Copper*? Provident *Nature* having so order'd it, that there should be a variety of *Metals*, suitable to our several Necessities.

The Reason of this multifarious production, must be fetch'd from the different *Juices* that lodge in the *Bowels* of the *Earth*, and are condensed there; for seeing that to the *generation* of *Metals* are required *sharp Spirits*, *Oily Exhalations*, and the *Fumes* of *Quicksilver*; these continually ascending from the Bowels of the *Earth*, to the more Exteriour parts, do there leave the *Metalline particles* they bring along with them, and according to their difference, are *generated* a great variety of *Minerals*, *Metals*, and other things dug out of the *Ground*. For as we find, that in the Fruits of *Trees*, the grosser Matter doth constitute such parts of them, and the more pure and *subtil*, others: So sometimes in the same *Vein* many *Metals* are generated, whereof some require a more crude and less elaborate Matter, as *Iron*, *Lead*, *&c.* and others a better prepared and more refined Matter, as *Gold*. Which is the Reason why a greater quantity of ignoble *Metals* are found in the *Mines*, than of the pure and noble; foraſmuch as *Nature* needs much more time for the bringing these to Perfection, than the other.

II. *Why Metals are malleable.*

All *Metals*, except *Quicksilver*, are Malleable.

This Property of *Metals*, is the consequent of their Nature and frame; for seeing that *Metals* are nothing else but *hard Bodies*, composed of many *Integral parts*, which, as to their *figure* are long and branchy, it cannot seem strange to any Considerative person, that they are *malleable* and *ductil* when they are forged on the *Anvil*, or drawn into *Wire*: For it may be easily conceived, that their parts being thus *figured*, may be so disposed, as that they may glide a good while one over another, or side-ways to each other, without wholly separating from one another. After this manner *Lead*, *Iron*, *Silver* and *Gold*, more than any of them, may be drawn into *Wire*, or beat into *Leaves*, of an incredible thinness.

III. *Why Metals are found at the Bottoms of Mountains, lying East and South.*

Mines of *Metals* are chiefly found under *Mountains*, and especially in those parts that face the *East* or *South-Sun*.

The Reason is, because at the bottom of *Mountains* there be many *Cavities* and *Clefts*, in which the sublimed *particles* of *Metal* may unite, and mount up together to the outward *surface* of the *Earth*, especially in those places which are most expos'd to the *Sun*, and admit its strongest and greatest *heat*. For tho' the *Sun-beams* do terminate on the *surface* of the *Earth*, and do not penetrate to the inmost parts of it; yet is it not to be question'd, but that the *Heat* produc'd by them, doth reach to the most abstruse and inward parts of it, and most strongly affect those parts which they most directly strike against. For the *Earth*, by the *heat* of the *Sun*, being Cleft into Gaps and Slits, way is made for the more easy mounting of the *Juices*, that are hid in its *Bowels*, and which depositt their Burthens, to wit, the *Metalline particles* they are charg'd with in the Upper parts of the *Earth*. And for the same Reason it is, that *Springs* do frequently rise at the Foot of *Mountains*, because the *water* finds a more easie passage through, and more ready ascent to them. Wherefore, whensoever any

Mineral or *Metal* is found mingled with the Upper-part of the *Earth*, we may conclude, that the same was carried up thither, together with the ascending *Vapours* and *Exhalations*.

IV. *What places do most abound with Metals.*

And this is the Reason why *Metals* are most frequent in those places, which are most expos'd to the *Solar Rays*, and which receive most of their *heat*; because *Heat*, by wasting of the *moisture*, makes such places full of *Clefts* and *Slits*, through which the *Juices* and *Metalline Exhalations*, may more easily ascend.

V. *Metals first detected by the Burning down of Woods.*

Tho' *Metals* consist of several *Juices*, and are now generally found in the *Mines*; yet it seems very probable, that their first Invention or Detection was owing to the conflagration of *Woods*. Thus ARISTOTLE tells us, that in *Spain*, when some *Shepherds* had set a *Wood* on *fire*, which kindled the *Earth* also, *molten Silver* was perceived to run down in the same place. Neither will this seem strange to any who shall consider, that in many places the Veins of *Metals* are found, reaching to the Roots of Great *Trees*, about which they are wrapped; wherefore when such *Trees* are burnt down, no wonder if the said *Metals*, that are entangled amongst the *Roots*, do melt down with the *heat* of the *fire:* In like manner as in the dreadful *Fire* of *London* 1666, the *Bells* in some *Steeples* were melted.

VI. *The Ground that is most rich in Metals, appears outwardly most barren.*

The *Ground* which is rich in *Mines*, is generally *Barren:* And besides exhales noxious *Steams* and *vapours*, which are very prejudicial to the health of the *Inhabitants*, and are the cause of many *Diseases*.

The Reason of this *Barrenness* is, because the *Alimentary Juice*, appointed by *Nature* for the Nourishment of *Herbs* and *Plants*, is otherways diverted, *viz.* to furnish Matter for *Metals*. And it is for want of this *Sap* or *Juice*, that in such places the *Trees* do languish, *Herbs* wither, and the *Earth* it self is bereft of its Vigour, Beauty and Ornament. These parts of the *Earth* also are more subject to noxious *Exhalations*, because of the great quantity of *steams* and *vapours* that abound within the *Bowels* of them. For we must not suppose, that all their Matter is spent in the making of *Metals*, but that the more *subtil part* of them being agitated by the Matter of the *first Element* passeth through *Clefts* to the *surface* of the *Earth*, and there mingling with the *Air*, doth infect the same, and becomes injurious to those that breath in it. This may be seen in most of the *Lakes* and *Pools* of *Zealand*, from whence they dig their *Turf*, which abound with *Bitumen*, and in burning give forth a nasty *stink:* Yea, the *steams* and *fumes* that proceed from them, do, as it were, gild over all the Furniture and Utensils of *Iron*, *Copper*, *Tin* and *Silver*, that are in the *Houses* where it is commonly burnt, and discolour all things but *Gold*.

VII. *Why Metals are found in some Rivers.*

Metals are sometimes found in *Rivers*, according to what *Historians* tell us of the Rivers *Tagus*, *Ganges* and *Pactolus*, as abounding with *particles* of *Gold* and *Silver*, which are gathered by the *Inhabitants*, and melted down into *Ingots*.

We must not imagin that *Metals* are generated in these *Rivers*, as they are in the *Bowels of the Earth*; but because the *waters* of those *Rivers* runing through the *Grounds* which abound with *Metalick Veins*, carry great store of their *particles* along with them. For *Water* of it self is not a fit Element for the *generation* of *Metals*, forasmuch as nothing can be expected from its union with *Earth*, save only a little *Mud* or *Clay*.

VIII. *Why Metals are more capable of Rarefaction, than Condensation.*

Metals are considerably rarefied by *Heat*; but are not subject to be condensed by *Cold*.

The Reason of this is, because *Metals* are already in the state of the highest *compression*, and have the whole weight of the *Atmosphere* lying upon them. Being therefore already thus compress, they are not capable of any further condensation; but well of *Rarefaction*. Thus we observe, that the *Air* is but little condensed by *Cold*, but very much rarefied by *Heat*; and that whenever it is freed from the weight of the *Air* that lies upon it, it becomes much more extended, than it can be compress or condensed by the most strong and effectual Engins.

IX. *Why Calcined Metals flow like Sand, and being melted, run like water.*

When *Metals* are *calcin'd*, that is, are reduced into *Powder*, by the means of *Corrosive Spirits*, they flow in *grains* like *Sand*; but if they be *melted*, they run like *water*.

The Reason is, because in *Calcination* they are not resolved into the very least *particles* they are capable to be resolved into; but only into small *grains*, which are still capable of a further dissolution or division. But when the said *Grains* are dissolved by the violence of *fire*, they are divided into much smaller *particles*, and constitute a more continuous *Body*, like *water*.

X. *Why Metals are resolved into Vapours.*

And much for the same Reason it happens, that *Metals*, by reason of an *Acid sulphur* which abounds in them, do fly away with it, and are dissipated into *fumes*. For when *Silver* is melted with *Lead*, as soon as a little *Brimstone* is cast into it, the *Silver* vanisheth, and is turned into *fumes*, except that its flight be stopt by *wet Linnen*. In like manner, *Copper* that is mixed with a piece of *Gold*, and cemented with common *Salt*, and the Powder of *Bricks*, it mounts upwards, and carries up some *Gold* along with it; except the *Pot*, in which the Operation is performed, be covered. Because the *Particles* of the *Metals* are carried upwards by the force of the *Fire*, and do not quit their agitation, but by meeting with some *cold Body*.

CHAP. II.

Of Quicksilver and Brimstone.

I. *Why Quicksilver is more heavy than any other Metals, besides Gold.*

Quicksilver, to which *Chymists* give the Name of *Mercury*, is the heaviest of all *Metals*, excepting *Gold:* And therefore all other *Bodies* swim on the top of it, without sinking to the bottom.

The Reason of this Ponderosity is, because there are fewer *pores* in *Quicksilver* for the *subtil matter* to pass through, than in other *Metals:* For the multitude or deficiency of *Pores* is the only Cause of the *Heaviness* or *Lightness* of *Bodies*. For tho' it might be granted, that the *Parts* of other *Metals* are of the same bulk and *figure*, and alike moved; yet forasmuch as they have many more *Pores*, they must needs be lighter than it. And this is the only Reason why *Gold* is heavier than *Quicksilver*, and sinks down in it, even because it hath

hath fewer *Pores*, and doth not admit ſo much of the matter of the *1ſt Element*; tho' indeed in this reſpect it doth not much exceed *Quickſilver*, ſeeing that the propertion between them, is as 44 to 43.

Which makes me the more admire, what ground PLINY could have to aſſert, *lib.* 33. *cap.* 3. that *Gold* is not ſo heavy as *Lead*, when experience aſſures us, that *Gold* is as heavy again, and compared with *Blacklead*, is as 10 to 6, and to *common Lead*, as 10 to 5 $\frac{1}{4}$.

II. *What is the cauſe of the Fluidity of Quickſilver.*

Quickſilver is *liquid*, and except it be contained in ſome *Veſſel*, it runs away like *water*.

The Reaſon is, becauſe *Quickſilver* is divided into many little *Particles*, which are agitated by peculiar *motions* differing from one another, and continually ſhift their places. And tho' it doth not wet or moiſten the *Hand* that handles it, yet cannot this hinder its fluidity: Becauſe *Moiſtneſs* and *Liquidity* are not one and the ſame *Quality*, nor are they of the ſame *Nature*. For *Fire* is *liquid*, and *Molten Metals flow*, and yet neither of them can be ſaid to wet or moiſten. Foraſmuch as nothing elſe is required to conſtitute the nature of *Fluidity*, but the motion of the inſenſible parts of any *Body*, or their being ſo looſe, as to be eaſily put into motion by the *ſubtil mater*. The cauſe therefore of the *Fluidity* in *Quickſilver* is, becauſe the *Particles* whereof it conſiſts, are ſo ſmooth and ſlippery, that they cannot be cloſely compacted together, and becauſe being thicker than the parts of the *water*, they ſcarcely afford any entrance to the *Globuli* of the *2d Element*, but only to that moſt *ſubtil matter*, which we call the *1ſt Element*.

III. *Quickſilver loſeth nothing of its weight.*

Hence it is ſaid, that *Quickſilver* when put on the *Fire*, doth not become diſſipated into *Fumes*; but being received into a *Veſſel*, it ſoon after returns to the ſame form it had before, without the loſs of any part of its weight.

IV. *How Mercury may be fixed, and afterwards reduced to its liquid ſtate again.*

Quickſilver that hath been fixed with *Quick-lime*, being put into a *coated Retort*, paſſeth into the *Recipient*, and there appears in its former ſhape.

Quickſilver is fixed when the *Particles* of *Brimſtone*, and of many other *ingredients* unite themſelves with thoſe of the *Quickſilver*, fixing the Points or extremities of their little *Branches*, in their *Pores*; and if it chance that the *Particles* of the *Quick-lime*, being put in motion by the *Fire*, carry away with them the *Particles* of the *Brimſtone*, or of any of the other *ingredients*, that united themſelves with thoſe of the *Quickſilver*, and hindred them from being moved, whether by ſtopping the paſſage of the *ſubtil matter*, or by rendring their *figures* too irregular, the *Quickſilver* returns again to its former ſtate.

V. *Why the drops of Quickſilver are round.*

Quickſilver always forms it ſelf into round *drops*.

Becauſe the *Intervals*, which the *Particles* of the *Quickſilver* leave between themſelves, are ſo little, that neither the more groſs, nor the more *ſubtil Air* can enter them, and therefore can only act upon the *ſurface* of it, that is, by continually puſhing back the parts of the *Quickſilver* towards the *Center*, until the ſaid parts reſiſt them equally on all ſides; which they never do, till they form themſelves into a *ſpherical figure*. Whence it follows, that the *Air* muſt of neceſſity make the drops of *Quickſilver* more exactly round, than thoſe of any other *Liquors* whatſoever.

VI. *How Quickſilver may be fixed.*

But notwithſtanding the parts of *Quickſilver* be thus *Round*, *Poliſht* and *Slippery*, yet doth not this hinder, but that by means of *Quick-lime*, *Brimſtone* and other *Ingredients*, it may be fixed, by darting the extremities of their little *Branches* into the *Pores* of it, which makes the *ſurface* of them ſo irregular, that the *ſubtil matter* which moved them before, being no longer able to agitate them, the *Quickſilver* becomes changed into a hard *Body*.

VII. *Why a Gold Ring attracts Quickſilver.*

Quickſilver ſeems to bear a great affection to *Gold*; and therefore they who are anointed with any *Mercurial Ointment*, if they hold a *gold ring* in their *Mouths*, the *Quickſilver* penetrating through the *Body*, fixeth it ſelf on the *Ring*, and maketh it to appear as if it were *Silver*, but being put into the *Fire* recovers its former *Brightneſs*.

The Reaſon is, becauſe *Quickſilver*, which we have ſaid to be a *Fluid Body*, and to have its parts in continual agitation, by a moderate *heat* doth exhale, and fly away into *Fumes*, and therefore being mixt with thoſe *Steams*, which together with the *Breath* are thruſt forth from the *Lungs*, it is carried upwards to the *Mouth*, where meeting with the *ring*, which is a compact and cold *Body*, it is ſtopt there, and by the union of its parts returns to its former ſtate. Much after the ſame manner as *water*, in an Alembick by *heat* is turned into *Vapors*, till meeting with a cold *Body*, it loſeth its agitation, and is changed again into the form of *water*. The *Quickſilver* therefore doth not attract the *Gold*, as ſome ſuppoſe, but only cleaves to it, and by thruſting it ſelf into its *Pores* becomes coagulated again, and recoves its former ſtate. And therefore *Phiſicians* adviſe thoſe that have been anointed, with ſuch *Mercurial Ointments*, to keep a *ring* of *Gold* in their *Mouths*, or to take *Gold* inwardly, that the *Fumes* of the *Quickſilver* may ſtick to it. And therefore thoſe perſons, who do frequently handle *Quickſilver*, as thoſe who *Guild Metals*, or are employed in *Chymical operations*, do commonly hold a piece of *Gold* in their *Mouths*, to catch the *Fumes* of *Quickſilver*, which otherwiſe might prove dangerous to their *Bodies*.

VIII. *Why Quickſilver betakes it ſelf to Gold.*

But you'l demand of me, why the evaporating *Fumes* or *Particles* of *Quickſilver*, do rather tend towards the *Gold*, than any other way.

The Reaſon is, becauſe the moſt ſubtil parts of the *Quickſilver*, being carried away by the agitation communicated to them, betake themſelves that way, where they find it moſt eaſy for them to continue their motion; and it is certain that they can purſue the ſame more readily in the *Gold*, than in the *Air*, becauſe there is nothing in the *Pores* of the *Gold* that doth oppoſe them, whereas the *Particles* of the *Air* do continually thwart and croſs their tendency. And accordingly we find, that when we *handle Quickſilver* with one Hand, and have *Rings* on the other, the ſame preſently become diſcoloured by the *Quickſilver*.

IX. *Gold and Silver are delivered from their droſs by the means of Quickſilver.*

Whereas formerly the *Spaniards* at the Mines of *Potoſi* in *Peru*, did ſeparate the *Gold* and *Silver* from the Droſs, with incredible charge and labour, *Fernandes de Velaſco* taught them a more compendious way, which they ever ſince put in practice,

to their great profit and advantage. He took *Quickſilver* and *Salt*, which he mixed with the Mine, and ſo put them together into cloſe covered *Pots*, which he placed in convenient *Furnaces*, and by this means the *Gold* and *Silver* uniting themſelves with *Quickſilver*, became ſeparated from their droſs, the *Amalgama* or mixture of the *Quickſilver*, and *Silver* being afterwards cleanſed, and made bright by reiterated Lotion

X. *Litharge mortifies the ſourneſs of Vinegar.*

Litharge when put into *Vinegar*, doth take away its ſharpneſs, and communicates a kind of *ſweet taſt* to it.

The Reaſon is, becauſe the ſharp pointed and unequal *Particles* of *Vinegar*, which do conſtitute its ſourneſs, cleaving to the *Particles* of the *Litharge*, are thruſt down to the bottom with it, and therefore no wonder, if the *Vinegar* being freed from thoſe ſharp pointed *Particles*, which prick the *Gums* and *Tongue*, appear to be of a *ſweetiſh taſt*.

XI. *Sublimate loſeth all its corroſive acrimony, by being ſublimed with Quickſilver.*

If to *Mercury Sublimate*, which is extreamly *corroſive*, an equal quantity of *Quickſilver* be added, and expoſed to *Sublimation*, the *Sublimate* loſeth all its *venemous corroſiveneſs*, and becomes inſipid, and a good *Medicin* in many caſes.

Becauſe the added *Particles* of *Quickſilver*, become increaſed in bulk by the *Particles* of *Salt* that are in *Sublimate*, by why means they become thicker, and their Points are blunted. After the ſame manner as when *Spirit* of *Vitriol*, and *Oyl* of *Tartar per Deliquium*, when mingled together loſe all their ſharpneſs: For theſe *Salts* being of different kinds, the one an *acid Salt*, and the other an *Alkali*, are no ſooner mixed, but they act upon one another, by which means both their Points are blunted, much in like ſort as when by rubbing the edge of one Knife againſt the other, both thereby become blunted.

XII. *Quickſilver taken inwardly, in any conſiderable quantity cauſeth Death.*

If a conſiderable quantity of *Quickſilver* be taken inwardly, it endangers the *Life* and often cauſeth *Death*.

The Reaſon is, becauſe *Quickſilver* being a very *Heavy* and *fluid Body*, doth eaſily enter the *Veins*, and mingling with the *Blood*, doth interrupt or quite ſtop its motion. Foraſmuch as by the weight of this *Metal*, the *Blood* becomes ſo condenſed, and its *motion* ſo much retarded, that it cannot furniſh *Spirits* enough to the *Brain*, for the ſupply of the *Nerves*. For the *Particles* of the *Quickſilver*, lying upon one another becauſe of their weight, do condenſe the *Blood*, and ſtop its agitation; and by this means, ſo ſmall a quantity of *Spirits* are conveighed from the *Brain* to the *Nerves*, that they can only interruptedly, and by *intervals* fill and diſtend the *Muſcles*. And this is the true cauſe, why thoſe who get *Quickſilver* out of the *Mines* have their *Gums* flaggy, and their *Teeth* looſe, becauſe the *Mercury* entring into the inmoſt parts of the *Body*, doth deſtroy and weaken their connexion.

XIII. *Quickſilver is very hurtful to the Body of Man by reaſon of its Acidity.*

The *Miners* that labour in the *Quickſilver Mines* of *Carinthia*, and others who are much converſant about *Quickſilver*, are generally ſubject to thoſe *Diſeaſes*, which are cauſed by the exceſſive uſe of *Acid things*, as with the *Palſy*, *ſhaking* of the *Limbs*, and other ſuch like *Diſeaſes* which affect the *Nerves*. For *Sourneſs* and *Harſhneſs*, ſeems to be predominant qualities in *Quickſilver*. For by its *Acidity*, it doth corrode moſt *Metals*; and being mixed with *Vitriol* and *Salt*, doth provoke copious *Salivation*; but when *Alkalious* or *Lixivous Salts* are mixed with it, it *Salivates* leſs, becauſe theſe do mortifie the force of *Acids*. And tho' theſe *Miners* faſten *Bladders* to their *Mouths*, to keep off the *poiſonous fumes* of this *Metal*, yet they commonly dye of the *Conſumption* or *Palſy*; becauſe *Mercury* by the tenuity of its parts, doth attack the original of the *Nerves*, and relaxes the *Veins*, and above all the *Lymphatick Veſſels*.

XIV. *How Mercury operates upon the Body of Man.*

Whence we may take notice that *Quickſilver* then chiefly exerts its *Virtue*, when it is divided into the ſmalleſt *Particles*. For ſeeing that its parts are very *Penetrative*, they diſturb the Maſs of the *Blood*, excite *Fermentations*, and frequently hurt the Members of the *Stomack*, whence *Bloody Fluxs*, *Vomiting of Blood*, and terrible *Gripes* do proceed. Becauſe the *Blood*, which by a continual Circulation runs through the *Body*, not being able to endure this troubleſome gueſt, and finding it ſelf unable to diſcharge him by *Sweat* or *Urin*, becauſe the *Pores* of the *Skin* and *Kidnies* are too ſmall for that purpoſe, ſends all away by the *Cæliacal Arteries*, and ſo cauſeth a *Bloody Flux* or violent *Looſneſs*.

XV. *Why Brimſtone doth abound in the Country about* Sienna *in* Italy, *in ſome Iſlands in* Sicily, *and in* Naples.

Brimſtone is found in great quantity, in the Country about *Sienna*, and in ſeveral *Iſlands* in *Sicily*, and in *Naples*, which abound with *Subterraneous Fires*.

The Reaſon is, becauſe the *Branchy Particles* of the *Exhalations*, which in conjunctions with thoſe of ſharp and *Metallick pieces* do conſtitute *Brimſtone*, are put into motion by the force of the *Subterraneous heat*, and carried upwards to the *ſurface* of the *Ground*, where they are coagulated into a fat and oily concretion, which we call *Brimſtone*. And for the ſame reaſon it is, that *Greaſe* and *Fat*, which likewiſe conſiſt of ſoft and thin *Particles*, do affect hot places, as abounding moſt in thoſe parts, where the heat is ſtrongeſt, as about the *Heart* and *Reins*, and other ſuch like where the heat abounds moſt. And as the *Fat* or *Greaſe* is generated in the *Bodies* of *Animals*, ſo is *Brimſtone* formed in the *Earth*, when the moſt *Oily parts*, by heat are carried up, and become condenſed about the *ſurface* of the *Earth*.

XVI. *Why Brimſtone is ſo inflamable.*

Brimſtone is very apt to be kindled, and in a moment, as ſoon as it toucheth the *Fire*, breaks forth into a *Flame*.

The Reaſon is, becauſe it conſiſts of the *Particles* of ſharp Juices, which are ſo intangled with the thin, and cloſe *Branches* of an *Oily matter*, that many of the *Pores* between the ſaid *Branches*, can only tranſmit the *Particles* of the firſt *Element*. Now it is evident, that the moſt thin parts are firſt put into motion, and ſeized by the intercurrent *matter*. And therefore *Brimſtone* is judged by *Phyſicians* to be hot in a high degree.

But yet we are told, that a kind of *Red Brimſtone* is dug up in *Carniola*, which neither burns like other ſorts of *Brimſtone*, nor hath a *ſtinking ſmell*, but when it is put to the *Fire* it melts like *Wax*. And therefore the *Romans* and *Grecians* made uſe of this in the *Expiation* and *Luſtration*, of their Houſes and other Places.

CHAP.

CHAP. III.

Of Salt.

I. *Of the several sorts of Salt.*

THere be different kinds of *Salt*, which do vary according to the different places of their *Generation*. There is one sort of *Salt* that is dug out of the ground, and is called *Salt Gem*, which is either taken up with *Sand*, or cut out of *Rocks*. For there are *Mountains* of *Salt* in several places, where *Salt* is cut, as *Stones* out of a *Quarry*, and grows again. Not far from *Astracan*, there are 2 *Mountains* so vastly great, and so abounding with *Salt*, that tho' every day 20000 great pieces of *Salt* are cut out of them, yet they do not appear the least diminished, the same quantity still growing up in the stead of that which was taken away. Another sort is that we call *Sea Salt*, which is made by conveighing the *Sea-water* into certain Beds, where by the *heat* of the *Sun* it is turn'd into *Salt*, by the evaporation of its *watry Particles*. The last is *Spring* or *Fountain-Salt*, which proceeds from *Salt Springs* or *Well-water*, and is boiled into *Salt*. All the difference between *Salt* that is dug out of the ground, and *Sea* or *Spring Salt*, is this, that the first of these, hath no *watry parts* mingled with it, and therefore doth not stand in need of any evaporation, as the other two sorts do.

The Reason of this difference is, because the *water* consists of 2 sorts of *Particles*, the one *Flexible*, the other *Inflexible*, which tho' they be confounded together, and constitute only one *Body*, yet do each of them retain their several *Nature*; and are never so closely united, but that they may be separated by means of the *Fire* or the *Sun*. When therefore the *Sea water*, which hath been conveighed into Beds, yields *Salt*, this is not because the *Particles* of the *water* are coagulated into *Salt*, as some suppose, but by the separation of them, forasmuch as the *Flexible* and *Fluid parts* are evaporated into *Fire*, leaving the *Stiff* and *Inflexible* behind them. Whence we may conclude, that the different kinds of *Salt* that are in the *World*, are such, because of the different *figure* of their parts: For the *Particles* of some *Salts* are like *Cylinders*, that is, round and long, of an equal thickness: Whereas others terminate in a Point, as may be experienced by the dissolution of them; and therefore an *Acid Salt*, will dissolve a mixt *Body*, which another cannot penetrate.

II. *How Salt is generated in the Mountains.*

Salt is generated in *Mountains*, when the *Salt water* being conveighed thither in great abundance, and separated from the *flexible Particles* of the *fresh water* running another way, the *Salt Particles* only remain in the cavities that happen to be there, and continually encreasing by the afflux of new *Sea water*, do at last wholy fill them up.

III. *Why Salt water is Transparent.*

Salt water is more Transparent than *Fresh water*; as appears, in that the *Bodies* that are in the *Sea*, are more distinctly perceived, than in *Fresh water*.

The Reason is, because the matter of the 2*d Element*, which is contained within the *Pores* of *Salt water*, doth retain more of its *motion*, than that which passeth through the parts of *Fresh water*, and consequently is more fit to transmit the action of *Lucid Bodies*. For *water* is therefore only said to be Transparent, because the *Æthereal matter* which fills the *Pores* of it, can transmit the action of *Lucid Bodies*.

IV. *Whence the different Virtue of Salts doth arise.*

All *Salts*, not only those of different kinds, but also those that are of the same kind, do differ in their *Virtues*. For we find, as was said before, that an *Acid Salt*, will dissolve a mixed *Body*, which other *Salts* of the same kind, cannot penetrate nor dissolve.

The Reason is, because the insensible parts of an *Acid Salt*, are of different *sizes* and *figures*, according to the different *size* and *figure*, of the strait *Pores* of the inward part of the *Earth* where they are formed. Therefore it is that *Vinegar* dissolves *Lead*, which the *Stygian waters* cannot do: And *Aquafortis* dissolves *Mercury* or *Quick-silver*, which *Vinegar* cannot penetrate: *Aqua Regalis* dissolves *Gold*, which *Aquafortis* will not touch; and on the contrary, *Silver* is dissolved in *Aquafortis*, which cannot fasten upon *Gold*. Now the reason of this variety of effects is, that amongst these *Acid Salts*, some have *long*, *thick* and *stiff points*, whereas those of others are *short*, *thin*, and somewhat *flexible*, wherefore also their *Virtues* must needs be different.

V. *Why Nitre increaseth the heat of Fire, and strengthens the cold of water.*

Nitre or *Saltpeter*, which in many things agrees with common *Salt*, increaseth the heat of *Fire*, and strengthens the coldness of *water*.

The Reason is, because the *Needle-like Particles* of *Nitre* are much more stiff than the sharp pointed *Particles* of the *Fire*, which are *flexible*, and therefore when these stiff *Saline Needles*, are mingled with those of the *Fire*, and are whirled about with them, they do much more strongly waste and consume, than the *Fire* which hath none of these mingled with it. And on the other hand, when these *Saline Needle like Particles*, fix their *points* into the *Liquid Globuli*, they retard their whirling about, and sometimes quite put a stop to it, and by this means it is very probable, that they promote congelation. Neither ought this diversity of effects be matter of any greater wonder to us, than when we see the same heat to soften *Wax* and harden *Clay*.

VI. *Why Nitre cannot be kindled but by a burning coal, or Flame.*

Nitre cannot be set on *Fire* by the most intense *heat*, but with a *Flame*, or a *burning Coal*.

The Reason is, because there can be no *Flame* without *Brimstone*. Now we find, that as soon as any *Brimstone* is cast into a Crucible, wherein melted *Nitre* is, a *Flame* immediately breaks forth from it, because the *volatile parts* of the *Nitre*, do afford a vehicle to the *Brimstone*, by means whereof it flies away in the form of a *Flame*. And this is the reason, why *Nitre* cannot be kindled into a *Flame*, by the most violent heat, but only by *Flame*, or by casting of a *burning Coal* into it.

VII. *Why common Salt crackles when it is cast whole into the Fire, but not so when it is beaten small.*

Common *Salt* being cast into the *Fire* in whole *Grains*, *crackles*, but when beaten into *Powder* it doth not; as neither doth that which is generated in *Lakes*, by the *heat* of the *Sun*.

The Reason of this is, the *rarefaction* of the *fresh water*, which is pent up within the *Grains* of *Salt*. For seeing that the parts of *Salt* that constitute these *Grains*, are only confusedly joyned together, without any intimate contact, they leave room enough, for some *Particles* of *fresh water* to come between them, which as long as they are not agitated, do continue there crowed together;

together: But when they begin to be toſſed by a violent *heat*, they dilate themſelves, and breaking their *Priſon walls*, make their eſcape with a noiſe. But the ſmaller *Powder* of theſe *Grains*, as likewiſe that *Salt*, which is coagulated on the *ſurface* of *Lakes*, do not make any crackling noiſe in the *Fire*, becauſe their *Priſon walls* are already ſuppoſed to be broken, and contain no *water*, that might be rarefied by the *Fire*. And hence alſo it is, that the *Particles* of *Salt* that have been dried with a ſlow *Fire*, do not melt without great difficulty, becauſe they are deſtitute of all manner of moiſture, and have no *Liquor* remaining, to promote their *Fluxing*.

VIII. *Salt eaſily turns to a Liquor.*

Common Salt, *Nitre*, *Salt of Tartar* and any other ſuch like, turns to *Liquor*. Thus the *Salt of Tartar*, for Example, being ſet in a *Cellar* in the Summer time eſpecially, on a ſhelving plate, or diſh, diſſolves into a fattiſh kind of *Liquor*, which *Chymiſts* call the *Oyl of Tartar per Deliquium*.

This effect muſt be aſcribed to the *watry Particles* that fly in the *Air*, under the appearance of *Vapours*. For *Salt of Tartar* being very ponderous, it is eaſily penetrated by the *watry Atoms* that are in the *Air*, and which afterwards agitating the *Particles* of the *Salt*, do ſeparate them from one another.

IX. *Why common Salt Melts being expoſed to the Air.*

For the ſame Reaſon it is, that common *Salt* melts when it is expoſed to the *Air*; not as if the pure *Air*, which conſiſts of thinner parts, were able to put the parts of *Salt* in *motion*, which it toucheth; but this is done by the *Particles* of *water*, that fly up and down in the *Air*, in the form of *Vapors*; and hence it is, that *Salt* ſeldom melts, except the Weather be inclined to moiſture.

X. *Why diſtilled Salts diſſolve Metals.*

Acid Spirits diſtilled from *Nitre*, common *Salt*, *Alom*, *Vitriol*, *&c.* diſſolve all manner of *Metals*.

Becauſe the *Dart-like Particles* of theſe diſtill'd *Salts*, entring the *Pores* of the *Metals*, do cut and tear them to pieces: For the inſenſible parts of theſe diſtill'd *Salts*, being in a continual motion cannot enter the *Pores* of theſe *Bodies* without dividing, and breaking them to pieces.

XI. *Whether flowers may be raiſed from their Salt.*

Chymiſts boaſt, that they can reſuſcitate the *Flowers* of *Plants* from the *Salt* that is extracted from them, and reſtore them to a new life.

Tho' this be confidently aſſerted by ſome, yet I take it only to be a figment, without any ſufficient ground or Foundation. For we experience, that the *Spirits* diſtill'd from *Vegetables*, are endued with very different *Virtues* from thoſe that are in the *Plant*, whence they were extracted. Thus we find that *Vinegar*, *Brandy* and *Wine*, which tho' they be the product of the ſame *Grapes*, yet differ ſo much in their *Virtues*, as that they ſeem to have nothing common with one another.

XII. *Whence it is that the Sea water ſeems to ſparkle by night.*

The *Sea water*, more eſpecially at ſometimes, ſeems to ſparkle in the night.

The Reaſon is, becauſe the *Particles* of *Salt* being ſtiff, and not in a condition to be bent or made plyable by the *Action* of the *ſubtil matter*, when they daſh againſt a *Rock*, or meet with any hard *Body* in their way, theſe *Saline Particles* do extricate themſelves, from thoſe of the *freſh water*, with which they were wrapt about, and thus ſtanding ſingly, and at ſome diſtance from one another, they produce the appearance of ſparks of *Fire*, not unlike to thoſe that are ſtruck out of a *Flint*. But yet all the *Saline Particles*, that are in the *Sea water*, do not produce this effect, but only thoſe that move with their *points* forward. Which is the reaſon, why theſe ſparks are not ſeen in all *Waves*, nor in all the *Drops* of one and the ſame *Wave*.

XIII. *Why Salt pricks and vellicates the Tongue.*

Salt put upon the *Tongue*, as ſoon as it begins to be diſſolved by the *Spittle*, doth prick and pierce it.

Becauſe *Salt* chiefly conſiſts of ſlender and ſtiff parts, which briſtling their *points*, do ſlaſh and cut the *Pores* and *Fibres* of the *Tongue*. For the *Saline Particles* are like ſo many ſmall *Darts*, which entring the *Pores* of the *Tongue*, do with great force vellicate and rend the parts of it. Wherefore they who will not admit that a Salt Taſt doth conſiſt in this, that the parts of the *Salt*, do with their Points prick the *Pores* of the *Tongue*, foraſmuch as they think they might as well touch the *Pores*, and *Fibres* of the *Tongue* ſideways only, without penetrating them with their Points, ought to conſider, that a *Needle* doth not prick but with its point, nor a *Sword* cut, but with its edge, the other parts of either of theſe being unable to inflict any wound: So that ſince a great many of theſe Points, are found in every crum of *Salt*, it can no more be conceived, that when the ſame melts in the *Mouth*, it ſhould ſtrike none of its little *Darts* into the *Pores* of the *Tongue*, than it can be imagin'd, that a *man* ſhould be able to walk with his *Feet* upon *Thorns*, without being hurt by them.

XIV. *Why Salt preſerves Meat from Corruption.*

Salt preſerves Fleſh from Corruption, and in time makes i to grow hard.

The Reaſon hereof may be gathered from the foregoing diſcourſe; for the parts of the *Salt* entring point-wiſe into the *Pores* of Fleſh, do not only rid it of the *moiſture* it did abound with; but beſides are like ſo many *Wedges*, driven in between the parts of it, where continuing unmoveable, they ſupport the ſame, and hinder the more ſlippery and plying parts of the Fleſh, to drive the others they are mixt with, out of their places, and by this means reduce the *Body* to Corruption. *Salt* therefore preſerves Fleſh and other things from Putrefaction, by the hardneſs and inflexibility of its parts; even as Boards are ſtrengthened, and made more firm with Nails, and as the ſtiffneſs of a *Sword* keeps the Scabbard from breaking.

XV. *Salt makes Bodies hard*

Thus we read that a *Girl* in *Holland*, by eating too much *Salt* became ſo ſtiff, and of ſo dry a Temperament, that ſhe could no longer move the *Members* of her *Body*. And from a parity of reaſon it is, that the *Venetians* to harden the *Wood*, wherewith they deſign to build their *Ships*, whilſt they are yet green, do lay them in *water*, and keep them there for many years; becauſe by this means the *Salt Alkali*, is hindred from exhaling, by which means the *Wood* is made more hard, and leſs ſubject to Corruption.

XVI. *How Salt promotes the Concoction of Meat in the Stomach.*

Common Salt helps and furthers the Concoction of *Meat* in the *Stomach*, and that becauſe it doth penetrate and divide it by degrees, and ſo diſpoſeth it for its more ready and ſpeedy Concoction, by the *Ferment* of the *Stomach*, and its reduction into the form of *Chyle*.

Tho'

XVII. *Salt makes the water liquid.* Tho' *Salt* makes ſome *Bodies* harder, yet it makes the *water* more *liquid*; for the parts of the *water* being long and pliable, they can eaſily twirl themſelves about thoſe of diſſolved *Salt*, which are long and ſtiff; which greatly facilitates their *motion*, becauſe they move always *bended*, after one and the ſame manner: And it is for this Reaſon, that *Salt* hinders *water* from *freezing*, as Experience teacheth us.

XVIII. *Salt makes the Earth fruitful, and produceth the ſame effect on fat or Corpulent VVomen.* *Salt* conduceth to the *Fruitfulneſs* of the *Earth*; and fat and corpulent *Women*, who for the moſt part are barren, by the moderate uſe thereof, become fruitful.

The Reaſon is, becauſe *Salt* penetrating into the *pores* of the Ground, doth ſuck up the noxious *moiſture*. For *Salt* hath a ſignal drying *virtue*, as hath before been mention'd: And therefore when an Old *Vine* begins to grow barren, if old *Urine* be poured to the *Roots* of it, it will become fruitful; for being before choaked with over-much *moiſture*, the *ſalt* that is in the *Urine* communicating a new *heat* to it, which dries up its ſuperfluous *moiſture*, makes it to bring forth copious and fair *Fruit*. And for the ſame Reaſon, the moderate uſe of *Salt* may be of good uſe, to make fat and corpulent *Women* fruitful; becauſe *Salt*, by its drying, heating and abſterſive *quality*, corrects and removes the *ſuperfluous moiſture* of the *Womb*, which otherwiſe might hinder the moſt Spirituous parts of the *Maſculine Seed* from reaching the *Female Ovarium*. It is alſo notorious, that *Salt*, by its *acrimony*, excites *Luſt* not only in *Women*, but alſo in *Men*. Now that *Salt* is a great promoter of *fruitfulneſs*, may be proved from that prodigious increaſe of *Mice* and *Rats* which is obſerved in *Ships*; and becauſe *Women* that are employed about *Salt-works*, are commonly more *fruitful* than others. And ſo likewiſe it is found, that the frequent eating of *Oiſters*, *Shrimps*, *Lobſters*, *Crabs*, and other *Shel-fiſh*, do ſtimulate *Venery*. For tho' *Salt* of its own Nature be *hard*, and being deſtitute of all motion, may be ſaid to be *Cold*; yet if we conſider it with relation to the effects it produceth in the *Blood*, and the whole *Body*, we muſt denominate it *hot*, becauſe it greatly excites and increaſeth the heat of the *Blood*; foraſmuch as it is a great promoter of *Fermentation*.

XIX. *A Grain of Salt, mixt with the Oil of a Lamp, hinders it from being ſo ſwiftly conſumed.* A Grain or 2 of *Salt* being added to the *Oil* that is in a *Lamp*, hinders it from being ſo ſoon waſted, as otherwiſe it would.

The Reaſon hereof is, becauſe the *Salt* being ſhaken with the *heat* of the *Lamp*, becomes dilated, and communicates ſome adſtringent *particles*, which being conveyed to the *wiek*, give ſome ſtop to the *Oil* in its paſſage, and prevent its aſcending and evaporating ſo ſuddenly, as it would, if there were none of theſe *ſaline Particles* to hinder it.

CHAP. IV.
Of Gold.

I. *VVhy Gold is yellow.* GOLD is of a *yellow Colour*, and the ſame very bright and pleaſant.

To underſtand the Reaſon of this, we are to conſider that the Nature of *Colours* conſiſts in this, that the *Particles* of the *ſubtil matter* that tranſmit the *Action* of the *Light*, are differently received, by reaſon of the greater or leſſer *Roughneſs* or *Smoothneſs* of the *Bodies* they light upon, and according as they obtain a ſtronger or weaker agitation from the manner or modification of their *Reflexion*; that is, according as the force of the *rotation* of the *Globuli*, that conſtitute the *Rays of Light*, doth exceed their *motion* in *right Lines*; or on the contrary. Thus, becauſe the *particles* which conſtitute the *Texture of Gold*, are ſo very rough and ſolid, as to produce a reverberation, whereby the *Globuli* are leſs twirl'd round, than when they produce a *red Colour*, and leſs than when they repreſent a *white*; this makes the *ſurface* of *Gold* to appear of a *yellow Colour*. For a *yellow Colour* ſeems to be nothing elſe, but a mixture of *white* and *red*, as may be proved by the mingling of a *red Liquor* with a *white*, whereupon a *yellow Colour* will enſue.

II. *Gold ſtruck yields a dull ſound.* *Gold* ſtruck with a *Hammer*, or other Inſtrument, yields a *dull* ſound.

The Reaſon is, becauſe *Gold* hath but a few *Pores*, and thoſe ſmall ones too; and ſeeing that the *Aiery matter* contained in them, is the *vehicle* of the *Sound*, when the *Body* is ſtruck upon, it is very evident, that where the quantity of *Pores* is leſs in largeneſs and number, there muſt alſo be a leſs concuſſion of the *Air*, and conſequently a weaker impreſſion made upon the *Organ* of *Hearing*.

III. *VVhy Gold cannot be conſumed in the fire.* *Gold* being melted by the violence of *Fire*, is not the leaſt diminiſhed thereby, or loſeth any thing of its weight or bulk. Hence proceeds that Common Saying of the *Chymiſts*, *Gold cannot be deſtroyed by Fire*; for tho' it ſhould continue for ſome Ages in a *Furnace*, it would not ſuffer any perceptible loſs thereby.

The Reaſon is, becauſe *Gold* conſiſts of ſuch thin *particles*, and thoſe ſo firmly woven together, that they cannot be ſeparated from one another. For tho' *Gold*, as well as all other *Bodies*, hath *pores* for the free paſſage of the moſt *ſubtil matter*; yet doth it not admit the *Globuli* of the 2*d Element*; which makes it extreamly *ſolid*, as containing a great quantity of *thick matter* under a ſmall bulk and ſurface. Now the *ſolidity* of any *Body* conſiſts in nothing elſe, but the cloſe connexion of its *parts*, and the ſmall number of its *pores*, both which make a *Body* indiſſoluble by any outward force.

IV. *Gold is the Heavieſt of all Bodies.* Such is the weight of *Gold*, that it far exceeds that of the moſt *heavy Bodies*. According to the *Paris Pound*, a *Foot* ſquare of it weighs 1368 *pound*: And compared with other *Bodies*, according to the calculation of ſome Curious Enquirers, if ſo much *Gold* weigh 100 Pound, the like quantity of *Quickſilver* will weigh $71\frac{1}{2}$; *Lead*, $60\frac{1}{2}$; *Silver*, $54\frac{1}{2}$; *Copper*, $47\frac{1}{2}$; *Iron*, 42; Common *Tin*, 39; *Loadſtone*, 26; *Marble*, 21; Common *Stone*, 14; *Cryſtal*, $12\frac{1}{3}$; *Wax*, 5; *Oil*, $4\frac{3}{4}$.

The Cauſe of the great Heavineſs of *Gold* is, becauſe its *Terreſtrial* and *Aqueous parts*, or, if you will, its *Sulphur* and *Mercury* are more perfectly and exactly mingled, than in any other *Bodies*; which is the Cauſe alſo, why their *pores* are leſs both in number and bulk: For beſides this compreſſion and compaction of the *parts*, we can allow of no other thing to be the Cauſe of the Heavineſs or greater weight of *Bodies*.

Neither

V. *Whence the malleability and ductility of Gold doth proceed.*

Neither is there any *Body* that is more capable of being divided and dilated, than *Gold* is, seeing that one *Ounce* of it only, as PLINY informs us, may be beat out into 750 *Leaves*, each of them being 4 *fingers-breadth* square: Yea, some tell us, that an *Ounce* of *Gold* may be beaten out to that degree, as to cover 10 Acres of *Ground*. But tho' this extension of *Gold* into *Leaves* be very surprizing; yet is it not to be compared with that Extension which the *Wire-Drawers* give to it. For one single *grain* of *Gold*, will yield a *Thred* of 400 *Foot* long; so that proportionably an *Ounce* will afford a *Thred* of the length of 230400 *Foot*.

The Cause of this vast Extensibility must be ascribed to the *softness* of its *parts*, and the singularity of their *Texture*; for the *softness* of the parts of *Gold*, makes them to yield without separation, so as that those parts which before were close and compact, are now drawn out at length. We experience something like this in *Potters-Clay*, and *fat Earth*, wherein tho' there be less of Extension, yet may they, by reason of their *softness*, be dilated into a considerable amplitude, according to the degree of their closeness and solidity, which furnisheth a sufficiency for the Matter to be extended, and enlarged into a vast capacity of *figure*. For the closeness and compactness of a *Body* doth furnish parts, which the more they are diminished in depth, the more they grow in breadth. Thus *Geometricians* demonstrate, that there may be *figures* of equal capacity, which yet are of an unequal compass: So that amongst equally capacious *figures*, those which do most deviate from a *Spherical figure*, do acquire a greater compass, without any increase of their Capacity, but only differenced according to Length and Breadth; whereas before it was gathered together about a Common Point.

VI. *The Connexion of the Parts, doth greatly hinder its divisibility.*

The peculiar *Connexion* which there is between the Parts of *Gold*, doth also greatly oppose their *division* and *separation* from one another: So that how much soever it be attenuated with a *Hammer*, or any other Instrument, it still retains the Connexion of its *parts*; and tho' it be not without some little *pores*, yet are they so entangled and woven together, and become pervious, that the *particles* of *Liquor* may run every way through them.

VII. *Why Gold suffers no diminution in the Fire.*

From the said close Connexion of the *Parts* of *Gold*, it is, as was said before, that it suffers nothing by the *Fire*; for tho' the parts of it being put into motion by the *Fire*, constitute a *liquid* or *fluid Body*; yet hath not the *fire* the power to separate any of them from one another, or to make them fly away into the *Air*. Provided it be pure *Gold*, such as is that which is found in the River *Hebrus* in *Thrace*, *Pactolus* in *Lydia*, *Tagus* in *Spain*, and the River *Po* in *Italy*. For whatsoever the *Fire* can separate from *Gold*, is something that is of a Foreign and Heterogeneous *Nature* to it, not being able to diminish or separate the least Integral part of it.

VIII. *Neither can it be destroyed or spoiled by all the Corrosive*

And the same may be said of *Stygian-water*; for tho' these do with great ease dissolve and corrode other *Metals*; yet cannot they enter the impregnable Fortress of *Gold*, nor with their Dart-like *particles*, loosen the *Texture* of its Parts. And tho' *Gold* may be dissolved in a peculiar *Stygian-water*, called by Chymists *Aqua-Regia*, as shall be said hereafter; yet is not the *Gold* in the least prejudiced by this Solution, or essentially changed: But may be restored to its former Condition, by pouring some drops of *Oil of Tartar*, into the Solution, with some *Common-water*, whereupon the *Gold* will fall to the bottom, and quit the *particles* of *Salt* which kept them suspended in the *Menstruum*. *Spirits of the Chymists.*

IX. *Why heated Gold doth burn and scorch more intensely, than any other Metals.*

Molten Gold, or that which is only *heated*, doth scorch more violently than other *Metals*, and preserves its *heat* longer.

This Effect is also to be attributed to the *Cohæsion* of its Parts; which being fat, and most closely compacted together, do long retain the *fire* that hath once entred them, and burn the *Bodies* that touch them more vehemently. For seeing that the *Pores of Gold* are very small, and only make way for the Matter of the *first Element*, the *Fiery particles* become so entangled in them, that notwithstanding their most swift and rapid *motion*, they cannot in haste disentangle themselves again; which is the reason that the effect of them is so vehemently impress upon combustible *Bodies* that touch it.

X. *How Gold comes to be dissolved in* Aqua-Regia.

The *Corrosive Spirit*, called *Aqua-Regia*, which is distill'd from equal parts of *Nitre* and *Vitriol* dissolves *Gold*; but not if you add thereto an 8*th* Part of *Common Salt*, or a 4*th* Part of *Sal-Armoniack*; for then it dissolves only *Lead* and *Silver*.

This proceeds only from the various Contexture of these *Metals*: For *Gold* hath its *pores* so disposed, as that the *particles* of *Nitre* and *Vitriol* may easily enter them, if they be alone without any mixture of common *Salt*, because of the likeness of *figure* that is between them. Whereas on the contrary the *pores* of *Silver* are so ranged, that they cannot admit the *particles* of *Vitriol* and *Nitre*. But the *particles* of *Common Salt* or *Salt Armoniack* being mixed with the *Vitriol* and *Nitre*, do so change the disposition of the parts of the *Menstruum* or Dissolvent, and make them so stiff, as to be able to thrust themselves into the *pores* thereof, and to dissolve it. There is also another sort of *Aqua-fortis* made of *Nitre*, *Alom* and *Vitriol*, which dissolves *Silver*, and is used for to separate it from the *Gold* that is mixed with it, which it doth not touch. For the *particles* that are in these corrosive *Spirits* do dissolve the connexion, which was between the *particles* of *Gold* and *Silver*; and that because of the different sorts of little *Bodies* that are found in these *Stygian-waters*, whereof some do agree with the *particles* of *Silver*, and disagree with the *particles* of *Gold*; and others, on the contrary, have an *Analogy* with the *particles* of *Gold*, but do not harmonize with those of *Silver*.

XI. *Why the Chymical Preparation, called* Aurum-fulminans, *doth make such a great Report, when it is fired.*

Gold reduced to *Powder* after a certain manner, and being afterwards kindled, gives a great Report, and like *Thunder* pierceth and breaks through whatsoever stands in its way, and therefore is called *Aurum-fulminans*, or *Thundering-Gold*.

This Effect will not appear so strange, if we consider the manner how this *Powder* is prepared. For first the *Gold* is dissolved in *Aqua-Regia*, and afterwards is precipitated with *Oil of Tartar*, and being taken out and dried, affords a *Powder*, which when it is heated by the *fire*, breaks forth into a *flame*,

Flame, with a vehement noiſe: For all the *particles* of the *Powder*, being kindled in one and the ſame moment, the force of the *Flame* proceeding from them, opens the *pores* of the neighbouring *Bodies*, and diſſolves the contexture of their *parts*, to make way for the *Gold* that is flying away, which breaks forth with that ſuddainneſs and violence, that it ſeems to imitate the noiſe of thunder, and the *quick Flame* of *Lightning*, both at once.

XII. *Aurum fulminans exerts its force upwards, as well as downwards*

Some have ſuppoſed, that the force of this *Aurum fulminans* did only tend *downwards*: But this is a miſtake, and the contrary may be proved by experiment. For if we put 2 grains of this *Powder* into a *Silver Spoon*, and cover it with a *Crown Piece*; as ſoon as the bottom of the *Spoon* is made hot by holding a lighted *Candle* under it, we ſhall find not only a deep dint made in the *Spoon*, but alſo that the *piece* of *Mony* is carried upwards. Which is an evident argument, that the force of this *Powder* doth not only tend downwards, but is diffuſed every way.

XIII. *How this Action of Fulminating Powder may be explained.*

This *Powder* is compoſed of 3 parts of *Nitre*, 2 parts of *Salt of Tartar*, and 1 part of *Brimſtone*; which being heated in a *Spoon*, flies away with a thundring report. For it ſeems very probable, that the *Brimſtone* and the *Salt of Tartar* contain abundance of the firſt *Element* in their *Pores*, which makes their parts very much diſpoſed to ſwim on the ſaid matter, and to fly away as ſoon as the volatil part of the *Saltpeter* is ſufficiently agitated by the *heat* of the *Candle*, to put them into motion; and as ſoon as the *Acid Salt* of *Sulphur* is ſufficiently divided, for to penetrate the *Salt of Tartar*.

XIV. *Why this Powder makes but a little noiſe, when it is kindled by a vehement Fire.*

Experience ſeems to confirm this, for when we kindle this *Fulminating Powder* with a vehement *fire*, it makes but very little noiſe, which probably proceeds from hence; becauſe the *Brimſtone* having not had time enough to melt, the *Acid Salts* could not ſufficiently divide themſelves, in order to their penetrating the parts of the *Salt of Tartar*; which makes the *Salt* to riſe with more difficulty, and conſequently leſs able to give a great report.

XV. *In Gold is hidden a great virtue against many Diſeaſes, if we may believe the aſſertion of ſome Phyſicians.*

Gold contains a virtue, proper to cure many *Diſeaſes*. For it is found to afford manifeſt relief to thoſe that are infected with the *Venereal Diſtemper*; it cures the *Elephantiaſis*, which is ſuppoſed to be the ſame with the modern *Leproſie*: It faſtens looſe *Teeth*, and heals all *Ulcers* and *Sores* of the Mouth.

But for my part I cannot think that *Gold* can cure any *Diſeaſes* in the *Body* of *Man*, unleſs it can be digeſted in the *Stomach*, or altered by the heat of the *Body*. For the virtue of a *Medicament* conſiſts in this, that the *particles* of it do inſinuate themſelves into the *Body*, expel the noxious humours, or by their congruity, cheriſh and corroborate the *diſeaſed* parts. But how can this be done as long as the *Gold* continues whole and *entire*, and loſeth nothing of its ſubſtance? Is it not notorious that the *Leaf Gold* wherewith the *Apothecaries* guild their *Pills*, doth paſs through the *Stomach* and *Bowels* untoucht, and is caſt out whole with the *Excrements*? And yet the ſaid *Leaves* are ſo very thin, that if the *natural heat* could exert any efficiency upon *Gold*, it would not fail to do it upon them, by reaſon of their great tenuity.

Neither is it to any more purpoſe that *Phyſicians* do boaſt of their *Potable Gold*, foraſmuch as this is found a meer invention of ſome *Mountebanks* to pick peoples Pockets. But ſhould we ſuppoſe that ſuch a *Potable Gold* might be prepared, yet would it be of no uſe in *Phyſick*, becauſe there would be no difference between this *Potable Gold*, and the common *Solid Gold*, but that the one is compact, and the other in a ſtate of ſolution or fuſion.

XVI. *Whether there be any Potable Gold.*

But you'l ſay, that *Corroſive Spirits*, *diſtilled* from *Salts*, can diſſolve *Gold*, and make it fit for a *Medicinal uſe*. I do not deny that *Gold* can be diſſolved in *Saline Spirits*; but yet I affirm, that this *ſolution* cannot be of any uſe to the *Body* for the cure of *Diſeaſes*, becauſe of the mixture of the ſaid *Corroſive Spirits* which are of a Deleterious Nature. And tho' it be common with *Phyſicians* to order the *boiling* of *pieces* of *Gold* in the *Broths* and *Gellies* of their *Patients*, for the ſtrengthning and reviving of them; yet is not this their practice founded upon any ſufficient experience, that *Gold* thus uſed, doth produce this effect; but only upon an inveterate Tradition received amongſt them. For ſeeing that nothing of the *ſubſtance* of *Gold* is communicated to theſe *Broths* or *Gellies*, it doth not appear how they can be of any uſe to the *Patient*; ſo that this cuſtom may very well be reckoned amongſt thoſe uſages which neither hurt nor help, and are only, as we ſay, like a *Chip in Pottage*.

XVII. *If Potable Gold could be had, it would be unprofitable and dangerous to be given inwardly.*

Chymiſts can change *Lead* and *Iron* into *Gold*, of which that famous *Nail* kept in the *Duke of Florence* his *Repoſitory* of *Rarities*, is a pregnant inſtance, which is ſo far *Gold*, as it was dipt in a certain liquor by a *German Chymiſt*.

XVIII. *Whether Lead or Iron may be changed into Gold.*

Tho' all perſons that ſee this *Nail*, generally believe the one part of it to be pure *Gold*, and to have been made ſuch by a *tranſmutation* of the *Iron* into *Gold*. Yet for my part, I am more apt to be of TACHENIUS his Opinion, who ſuppoſeth that this part of *Gold* hath been artificially joined to the *Iron* part of the *Nail*, by *Appoſition*, without any *Tranſmutation* at all. For after that this *Artiſt* had thus joined a piece of *Gold* to the *part* of an *Iron Nail*, it was eaſie for him to give to the *Golden part* the *Colour* of *Iron*, that ſo the whole *Nail* might appear to be *Iron*: But being afterwards put into the *Fire*, and then held in *Oyl* for ſometime, the ſuperadded part appeared to be true *Gold*.

XIX. *Gold is not ſubject to Ruſt.*

Another thing obſervable in *Gold* is, that it is not obnoxious to *Ruſt*; and this becauſe no *ſteams* proceed from it; and tho' ſometimes it ſeem to be Tarniſht, this doth not proceed from it ſelf, but from the too frequent handling of it.

CHAP. V.

Of Silver and Tin.

I. *Why Silver is hard to melt.*

SILVER doth ſtrangely reſiſt *Fire*, and is hard to *melt*, becauſe its *parts* being very ſmall and ſolid, makes a *Body* ſo compact and continuous, that the *Fire* cannot eaſily penetrate it; which is the reaſon that *Silver Smiths* and others, are obliged to make uſe of ſome expedients to make it *melt* the more readily.

II. *Why Silver may be beaten into thin leaves.* *Silver* is easily extended under the *Hammer*, because its parts being long and branchy, they may glide a long while one over another, without breaking asunder.

III. *Why Silver is of a white colour.* The reason of the *whiteness* of *Silver* is, the solidity of its *parts*, which reflect the whole light they have received; and with the same action wherewith they have received it. For the *particles* of *Silver* being of a *Spherical Figure*, and having a circular motion, consequently make no change in the *Rays* of *Light*; and tho' some of them may be conceived to be rough, yet do they reflect the *Rays* every way, and send them to the *Eye*, without any detorsion, or turning of them aside. Yet is not this *Colour* constant and perpetual to this *metal*; for when it is polisht, it loseth its *whiteness*, and becomes *Bright* and *Shining*; because its *white particles* do now reflect the Light towards one part, which makes all the other parts to look *dark* and *black*, as being hindred to reflect the *Beams* they have received, to the *Eye*.

IV. *How it comes to pass that Silver draws black lines upon Paper.* *Silver*, tho it be *white*, yet draws black *Lines* upon *Paper*; because by this rubbing of it against the *Paper*, some small *particles* of the *Silver* are rubb'd off; which forasmuch as they are thin and rough, do as it were imbibe or swallow the *Beams* of *Light*, and consequently exhibit a *Black Colour*. But yet they retain something of their former splendor, because some of the greatest *particles* stick out above the rest; which preserving their former Texture, do reflect the *Rays* after the same manner as they did before; because being very solid, and consequently very capable of being reduced under an even and polisht *surface*, they resist the Suns *Beams*; and causing them to be reflected under the same Angles, as they received them, they produce the sensation of *Light*, for the reasons we have set down at large in our *Institution of Philosophy*.

V. *Why Silver yields a shriller sound than Gold.* *Silver* yields a most shrill *sound*, and being struck with a *Hammer* or other *Instrument*, doth affect the *Ears* with a more smart and loud noise than *Gold*.

The reason of this is, because *Silver* is bent like a *Bow*, whose parts being left at liberty, do presently return to their former state. For it is evident that the *Strings of a Lute* yield a shriller or more *Treble sound*, the higher they are wound up, because it is then they are most swiftly moved, that is, make most frequent Excursions. Whereas *Gold* being softer, and having fewer *pores*, doth more easily give way to its being struck, and doth more slowly move the Air. Now the swiftness of the trembling *motion*, or undulation of the *Air*, makes a *shrill* or *Treble sound*; as the slowness of them, a *Base* or *Deep Sound*. And therefore *Speaking* or *Singing* makes a greater *noise*, than a violent *Wind*, because the *Air* that strikes the *Wind-Pipe*, when we are *Singing*, is much more swiftly moved than the *Winds* are. *Silver* therefore gives forth a more *shrill sound* than *Gold*, because its *bent* parts do more swiftly drive the *Air*, and impart a greater trembling or undulation unto it.

VI. *If Brimstone be cast upon Silver that is melted, it reduceth it to powder.* *Melted Silver*, by casting *Brimstone* upon it, becomes turned into a *Calx*, and is reduced into a small *Powder*.

This Change is brought about by the *flaming Brimstone*, which enters the *pores* of the *Silver*, and mingles with it, and by this means breaks some of the thinner parts of it, or drives some of them away from the rest, leaving the grosser, and in a manner, the whole substance behind. For by *Calcination*, the *Chymists* understand nothing else, but the reducing of the Body of a *Metal* into *Powder*, by the ridding of it from its *volatil parts* only. This being the difference between the *Ashes* and *Calx* of a thing, that *Ashes* are the Remainders of those *Bodies*, whose greatest part hath been consumed by *Fire*; but *Calx* of those *Bodies*, which do in a manner remain whole and entire after they have been burnt in the *Fire*.

VII. *Spirit of Nitre easily dissolves Silver.* *Silver* is readily dissolved in the *Spirit* of *Nitre*, or *Aqua Fortis*, but not in *Aqua Regalis*, which dissolves *Gold*.

The Reason is, because the *Spirit* of *Nitre* hath such an Analogy with the *Pores* of the *Silver*, that it enters the same, only accompanied with the matter of the first *Element*, by which means the *particles* of it have all the quickness of that *Element* communicated to them, and thereby is made fit to unravel the whole Texture of that *Metal*. And the reason why the *Aqua Regalis* doth not touch *Silver* is, because the *Pores* of the *Silver* are so small, in comparison of those of *Gold*, that the *Royal Water* which enters the body of this latter only surrounded with the first *Element*, cannot penetrate the *Pores* of the former.

VIII. *The Pores of Silver are less than those of other Metals.* That the *Pores* of *Silver* are lesser than those of *Gold*, and of all other *Metals* appears in that the *particles* of *Lead* in fusion, do mingle and join themselves more readily with any other *Metal* than with *Silver*, which they do only slide over. The same may also be gathered from this *Experiment*, that when we make the *Infernal Stone*, which is nothing else but *Silver*, made corrosive by the *Salts* of the *Spirit* of *Nitre*, we find that one ounce of *Plate Silver* is only encreased 3 *drams* in weight; whereas when we employ courser *Silver* for this Operation, we find the weight augmented no less than 5 *drams*. Which difference, in all probability, ariseth from hence; for that *Plate Silver*, being more fire and pure, hath lesser *Pores* than the courser *Silver*, which has an allay of other *Metals*, and therefore retain more of the *acid parts of the Nitre*.

IX. *A Vessel that is tin'd over, doth more resist the Fire than another that is not.* *Tin*, which *Chymists* look upon as a middle thing between *Silver* and *Lead*, hath properties distinct from them both; for *Vessels* that are *tin'd* over, are found to resist the *Fire* better than others, and are not so easily melted.

The Reason is, because *Tin*, which abounds with *Quicksilver*, doth easily stop up the *Pores* and Cavities of *Vessels*, and therefore hinders the *particles* of the *fire* from separating the parts of it so readily, as they would otherwise do. And therefore *Chymists* commonly call *Tin* the *Defender of Metals*, because it preserves them from the force of the *Fire*; for it enters so deep into the *pores* of the *Metals*, that it cannot, without extream *heat*, be expelled thence. But yet if we touch the *Tin* with a *Red hot Iron*, it presently melts; because by this means the *particles* of the *Fire* are introduced into the wider *pores*, which causeth the immediate separation of the *parts* of it.

X. *Why Calcin'd Tin is more heavy than that is not.* *Tin* is the lightest of all *Metals*, but when *Calcined* it is heavier, than when it is whole and entire.

The

The *Lightneſs* of *Tin* is not to be attributed to the leſs quantity of *moiſture* it contains, in compariſon of other *Metals*, as *Silver*, *Copper*, &c. but to the *magnitude* of the *pores*. For ſeeing that *Tin* is no ſimple *Body*, but contains many *Heterogeneous Parts*, which cannot ſo exactly cloſe together, conſequently large *intervals* muſt be left between them, to be filled with the *ſubtil matter*. Now nothing is more evident, than that the *Lightneſs* of *Bodies* proceeds from the magnitude and multiplicity of their *pores*: And therefore the reaſon why one *Metal* is lighter than another, is only this, becauſe it hath more and wider *pores*, which ſet their *parts* at a greater diſtance from one another. But that *Calcined Tin* ſhould be more heavy than *uncalcined*, ſeems ſtrange, foraſmuch as we find the contrary in other *Bodies*. Thus *Dough* is more heavy than *Baked Bread*, and a *Calcined Stone* is much lighter than another that is not *calcined*: However no other reaſon can be aſſigned hereof, but that the *pores* of the *Tin*, by *Calcination*, are more contracted, which is ſufficient to make it more heavy, than it was before *Calcination*.

XI. *How Tin may be reduced to Powder.*

But how comes it to paſs, that ſeeing *Tin* is *malleable*, yet it may eaſily be turned to *powder*, if being melted, it be ſtirred continually till it be grown cold.

The Reaſon is, becauſe this continual *motion* ſeparates its parts one from another, in ſuch a manner, as that they can no longer unite themſelves together; not only becauſe the *Air*, which is got between them oppoſeth their union; but alſo becauſe their ſmall *Branches*, being grown *Cold*, are not pliable enough to entangle one another, and therefore they remain in *Powder*.

XII. *Why a Tin Bullet proves more dangerous to the Body that is wounded with it, than a Lead Bullet*

A *Tin Bullet*, ſhot into a *Mans Body*, makes a more dangerous *wound* than a *Leaden Bullet*, tho' they be both of the ſame bigneſs, and diſcharged with the like quantity of *Gunpowder*.

The Reaſon is, becauſe the outward parts of *Tin* are more rough, and abound with ſharp prominences: By this means, as they enter the *Body*, they do much more plentifully affect the *Fibres*, by tearing and rending them to pieces: Or elſe we may ſay, that thoſe ſmall *Bits* and Shavings as it were, which the *Bullet* leaves in the *wound*, do infect and taint it; as we ſee that the *Teeth* of a *Mad Dog*, and of a *Viper*, do *poiſon* the *wound*, which poiſon ſoon after is conveyed throughout the whole *Body*, and cauſeth the Death and Corruption of it.

CHAP. VI.

Of Lead, and Copper.

I. *Why Lead is ſo eaſily melted.*

LEAD is eaſily bent, and as readily melted when put upon the *Fire*.

The Reaſon hereof is, the weak and ſlender adhæſion of its *parts*; for *Lead* conſiſts of ſuch *particles*, as are all of them eaſily ſeparable from one another, and therefore they are no ſooner ſet upon the *fire*, but that they are immediately put into *motion*, and readily ſeparated from one another. For *ſoft Bodies* differ from *Hard*, in that the parts of the latter touch one another, and are at reſt; whereas the parts of *fluid Bodies*, whoſe Nature *ſoft Bodies* partake of, are agitated with various *motions*, and whirl'd about their own Centers. *Lead* therefore readily melts, becauſe the *fire* with great eaſe enters the *pores* of it, diſſolves its parts, and varies their Poſition. Hence ſome have been of opinion that a *Lead Bullet* might be melted, meerly by a ſwift motion. But I cannot imagine that this can ever be effected by motion alone; for it was never found that *Lead Bullets* were ever found melted upon their being diſcharged from a *Muſquet*.

II. *Why Lead is more heavy than Iron.*

Lead doth not differ from *Iron*, ſave only in this, that it conſiſts of parts that are leſs, and more ſmooth, and whoſe *Branches* are more tender and pliable than thoſe of *Iron*: For becauſe the parts of *Lead* are ſmoother, therefore they lie more cloſe together, and ſo compoſe a more compact *Body*, ſuch as contains more of its own matter than *Iron* doth under an equal ſurface.

III *Why Lead is leſs hard than Iron.*

And ſeeing that the *Branchy Particles* which conſtitute *Lead*, are more ſoft and pliant, than thoſe that compoſe *Iron*, therefore they leſs reſiſt diviſion, and conſequently are not ſo hard as thoſe of *Iron*.

IV. *How Lead comes to be uſeful in Phyſick and Chyrurgery.*

Lead is endowed with a *Cooling* Virtue, and mitigates the *præternatural Heat* excited in Mans *Body*: Yea ſome, whoſe recovery hath been doubted, have been reſtored to their former health, only by the application of a *Plate* of *Lead*; as it is related of a certain *Muſician*, who wearing a *Leaden Plate* upon his *Breaſt*, only to preſerve his *Voice*, was by the ſame means cured of a moſt dangerous *diſeaſe*.

The Reaſon of this Refrigerating *Virtue* in *Lead* is, becauſe its parts are very ſlowly and remiſſly moved; and lying upon one another, are in a manner quite at reſt. For *Cold* doth not conſiſt in abſolute Reſt, or a total privation of *motion*, but it is ſufficient to conſtitute a *Body Cold*, if the parts of it be very ſlowly moved, and that the *Organ* of him that toucheth it, be more than ordinarily affected therewith. For a Body, whoſe parts are very ſwiftly moved, is more ſenſible of *Cold*, than another whoſe parts are more remiſſly agitated. A *Plate* of *Lead* therefore doth cool an *overheated* Body, becauſe it diminiſheth the *motion* of its *particles*, and doth mitigate and allay the noxious *heat*, which conſiſts in motion. Hence it is that *Plates* of *Lead* are applied to the *Reins* of thoſe who are troubled with involuntary Emiſſions, cauſed by the heat of their *Reins*. CALVUS, the *Orator*, made uſe of this means to quell and repreſs the motions of *Luſt*, to the end he might preſerve all his *Bodily Vigour* and ſtrength, for his *Study*. Chyrurgeons alſo make uſe of *Lead*, for the *drying* and *healing* of *Wounds*; for by obſtructing the *pores* of the *Body*, by its coldneſs, it ſtops the *humour*, and hinders it from ſpreading any further.

V. *Why Lead, being melted, and ſtirred with a Stick till it be cold, turns to Powder.*

Molten Lead, being ſtirred with a Stick continually, turns into a fine Powder.

The Reaſon is, becauſe by this vehement and continual *motion*, the more thin and ſlippery parts of the *Lead*, that kept the groſſer parts together, fly away into the *Air*; as we ſee in *Boiling Water*, which, when it is ſtirred, doth ſend forth a thicker *ſmoak*; for the heat having ſeparated the *particles* of the *Water*, many of them fly up into the *Air*. And thus the more *Oily particles* of the *Lead*, being left by themſelves, do come nearer together,

together, and are joined together more firmly than ever before, much after the same manner, as by the continual beating and concussion of *Cream*, its *superfluous particles* unite together, and constitute the *Body* of *Butter*, a-part from the *Whey*, wherewith they were mingled before.

VI. *Why Lead cannot be dissolved in Aqua-fortis.*

Lead is not dissolved in *Aqua-fortis*, tho' it be left in it never so long.

The Reason is, because the *Particles* of *Lead* are not proportioned to the *bigness* or *figure* of the *Particles* of that *water*, or corrosive *Spirit*, which therefore cannot penetrate them; or if they do, which indeed seems more probable, they penetrate them accompanied with the matter of the 1*st* and 2*d Element*, yea, and it may be with the more subtil part of the *Air* also, which makes the motion of them so slow, that they are not strong enough to break the Ranks and Files of the *Particles* of the *Lead*.

VII. *Why Copper is so hard to be melted except it be kindled with Fire.*

Copper is accounted amongst the hard *Metals*, which because of the close connexion of its parts doth long resist the *Fire*, and is not melted except that it be first kindled, and shed so much Light, as that it appears like a bright shining *Star* in the *Furnace*.

The Reason hereof is, because the 1*st Element* is so shut up in the strait and narrow *Pores* of the *Copper*, that the insensible parts of that *Metal* swim upon it, and are so violently tost together by the said *Element*, and whirled round about their own Centers, that they affect the *Optick Nerve* at a distance, and the *Nerves* of the *Touch* nearer hand. However when it is thus melted, it cannot endure any moisture to touch it; for if *water* be pour'd upon it, or any moist Body be dipt into it, it causeth a great noise, and the *Copper* leaps out of the Vessel. Because the *water* which is heavier than it, doth easily enter its *Pores*, where it becomes dilated because of the intense heat of the *Copper*, and being not able to continue there by reason of the straitness of the place, it breaks forth with violence, and carries the neighbouring *Particles* of the *Copper* along with it, and scatters and spills them: In a manner not much unlike to that whereby *Gunpowder*, that is covered over with little Stones, as soon as it is kindled, breaks forth with a noise and scatters all the Stones abroad.

VIII. *Whence the Effervescence or Ebullition proceeds which is seen in the dissolution of Copper.*

When *Spirit* of *Nitre* is poured upon *Silver*, it presently causeth a great *Ebullition*, so that it heats the *Vessel*, and continues till the dissolution of the *Metal* be performed.

The cause of this *Effervescence* is, because the *Particles* of the *Spirit* of *Nitre*, are of such a magnitude and *figure*, that they enter the *Pores* of the *Copper* only, accompanied with the matter of the 1*st Element*, which carries them along with it, with so much swiftness, as that they are able to separate the parts of the *Copper*, and to cause that *Ebullition* and *heat* which upon the solution of the parts is produced. Which is an evident proof, that the *Pores* of *Copper* are much more open, than those of any other *Metals*. For this great Effervence which happens upon the dissolution of *Silver* in this *Spirit*, seems probably to proceed from nothing else, but from the largness of the *Pores* of *Copper*, which are so great that the *acid Particles* of the *Spirit* of *Nitre*, enter into them surrounded with much of the matter of the 1*st Element*.

IX. *Why Tin and Copper when melted together become so very hard.*

Copper and *Tin* being melted together grow very hard, beyond what each of them were apart, before they were mingled.

The Reason is, because the *Tin* doth penetrate and fill up the *Pores* of the *Copper*: For certain it is, that *Tin* is a *Metal* of such a *penetrating subtilty*, that it joyns it self with other *Metals*, after a most peculiar manner; for it penetrates them even before that they be melted together, and by this means hardens them, as may be seen in *Iron*, that is tind over, and *Pins*, which when made red hot in the *Fire*, are dipt into *Tin* for to whiten them, and to bring them to that hardness which we find they have.

X. *Why Copper contracts a Rust call'd Verdigrease*

Copper easily contracts a *Blewish coloured Rust* which is proper to it, and therefore called in Latin *Ærugo*, which grows to it, and sullies it.

This *Ærugo* or *Copper rust* proceeds from the *Exhalations*, and *Sulphureous Particles*, which contiually steam forth from the *Particles* of the *Copper*, and stop the *Orifices* of the *Pores* thereof. It derives its original from the *moisture* of the *Air*, which is mingled with the parts of the *Copper*, which being put into motion by the *subtil matter*, doth break forth, and being stopt on the *surface* of it, doth there grow together into a *Rust*. After the same manner as we see that an *hoary moldiness* doth grow on the outside of *Flesh*, *Leather*, *Bread*, and other like *Bodies*, if they be kept in a moist place, and especially if they be sprinkled with *Salt*, because the *Salt* doth open and widen their *Pores*, and makes an open way for the *Sulphureous Spirits* to evaporate. Hence it is, that clean and smooth *Copper*, doth more easily contract its *Rust*, than that which hath a *rough surface*; because in smooth and scoured *Copper* the *Pores* are wider, and consequently the moist *Air* doth with more ease insinuate it self into them.

XI. *How Copper Rust is caused, and why Gold is not subject to Rust.*

This *Copper-rust* is caused by *sprinkling Salt*, and *Vinegar* upon plates of *Copper*; because both these do open and widen the *Pores* of it, and makes a ready way for the steams to come forth: Moreover, this *mixture* of *Salt* and *Vinegar* stops the *Particles* of these *Exhalations* on the *surface* of the *Copper*, and causeth them to grow together there, so as to cover the top of it. And it is for the contrary reason, that *Gold* is not subject to any *Rust*, because no steams proceed from it, so that it is not subject to be sullied or discoloured by any thing that comes from it self.

CHAP. VII.

Of Iron and Steel.

I. *How Iron which is so hard a Metal comes to be extended by being made red hot.*

IRon is the *hardest* of all other *Metals*, as being more difficult to be melted than any of the rest; and yet being put into the *Furnace* and made *red hot*, it becomes extended in length. For if we take a *Plate* of *Iron* of the same bigness with a piece of *Wood*, and cast it into the *Fire* till it be *red hot*, we shall find upon the taking of it out, that it is grown longer than it was when we put it in.

The Reason is, because the *Fire* that is got into the *Pores* of the *Iron* doth widen them; for seeing that there can be no penetration of dimensions, and that 2 extended substances cannot be in one and the same place, it cannot be, but that the *Iron* must be

be dilated by admiſſion of the *fiery Particles*, and conſequently acquire a new *Extenſion*.

II. *Why Iron is one of the lighteſt Metals.* Tho' *Iron* be hard to melt, yet it is one of thoſe *Metals* that are lighteſt, and are moſt eaſily diſſolved in *corroſive Spirits*, and deſtroyed by *Ruſt*; for the ſmall *Branches* of the parts that compoſe it, being greater and at a farther diſtance from one another, than thoſe of the other *Metals*, make this *Metal* much more *Porous* and *Spungious*, than ſome of the more compact and ſolid *Metals*.

III. *By what means Iron may be changed into Copper.* *Iron* beſmeared with *Vinegar* and *Alom* becomes like *Copper*. At *Smolnick* there is a *Well*, the *water* whereof being turn'd in Channels diſpoſed in 3 rows, turns plates of *Iron* into *Copper*.

The cauſe of this *Tranſmutation* is not as ſome would have it, the loſs of a former ſubſtantial Form, and the *generation* of a *new* one, but only an acceſſion of new parts, whilſt the *Particles* of *Alom* and *Vinegar* fill the parts of the *Iron*, and ſo change the former connexion of its parts. For ſeeing that *Vinegar* is of that ſharpneſs, whereby it eaſily penetrates into the *Pores* of the *Iron*, by this its penetration it changeth the order and diſpoſition of them, and by this means a new colour is produced in the *Iron*. Neither doth the *Allom* conduce leſs to this *Tranſmutation*, which being endued with a very adſtringent *Virtue*, doth tranſplace thoſe *Particles* which before ſtuck very cloſe together, and were firmly entangled. And therefore it is no wonder, that when the *Texture* of the *parts* of *Iron* is changed, it ſhould by this means come to reſemble *Copper*.

IV. *Why Iron grows harder by being caſt into water when it is red hot.* If *Red-hot Iron* be taken out of a *Forge* or *Furnace*, and put into the *water*, it becomes *harder*, than when it is only expoſed to the *Air*, and cooled there by degrees.

The reaſon is, becauſe the *Pores* of *Iron* when *red hot*, are very open, and only filled with the matter of the 1*ſt Element*, but mingled with many *particles* of the 3*d Element*, which ſwimming upon the *Fire*, do continually enter them, and come out again. Whence it comes to paſs, that when, in this ſtate, it is expoſed to the *Air*, to grow cool, the ſelf-ſame *particles* of the *Air*, continuing their courſe through its *pores*, cauſe the *pores* to be ſtraitned by degrees, and make the parts of the *Iron* to retain the ſame Form they had in the *Furnace*. Whereas, when *red hot Iron* is plunged into *Water*, it cannot indeed hinder the matter of the 1*ſt Element* from breaking out from the *pores* of the *Iron*; but becauſe there is nothing that can take up thoſe *places*, beſides the *ſubtil matter* which is in the *Water*, whoſe *particles* are too ſmall to keep the *pores* open in the ſame manner as they did before, they thereupon become ſuddainly ſtraitned, and conſequently come nearer together; which is the cauſe of its attaining a greater degree of hardneſs, which is nothing elſe but a cloſe compreſſion of the parts of a Body, and their mutual contact.

V. *Why Ruſt ſtops, and hinders conception.* *Ruſt* ſtops the Courſes of *Women*, and given inwardly, hinders *Conception*.

The Reaſon is, becauſe *Ruſt* conſiſts of *Sulphureous*, *Branchy* and *Angulous parts*, which are very adſtringent, and ſtop up the *Orifices* of the *Pores* they light into. As may be ſeen in the Hands of thoſe that handle it, which cannot without grat difficulty be waſhed clean.

It is found by Experience, that *Iron* and *Steel* have abundance of *Pores*, which are turned and go winding like *Screws*, and that by means of theſe, it approacheth to the *Loadſtone*.

VI. *How it comes to paſs that Iron and Steel have Pores turned like Screws.* The cauſe of theſe *Screw-like Pores* that are in *Iron* and *Steel* is, thoſe little *Striate Particles*, which according to what we have delivered in our *Inſtitution of Philoſophy*, continually coming forth from the inward parts of the *Earth*, and paſſing into the outward, have ſo penetrated the ſubſtance of the *Iron* and *Steel*, as to make paſſages for themſelves through it, which they will ſtill keep open by continuing their motion through them. Which they could not do, without framing the *Pores* of the *Steel* and *Iron* like ſo many *Screws*, which differ nothing from the *Screw-like Pores* that are in the *Loadſtone*, ſave only in this, that the little *Branches* of the *Particles* of the *Iron* and *Steel*, which riſe in their *Pores*, ſtand in need to be beaten down, and ſmoothed by the *Particles* of the *Loadſtone*, for to afford them a free paſſage.

VII. *Wherein Iron and the Loadſtone do agree.* And therefore *Iron* is ſaid to be of kin to the *Loadſtone*, becauſe both of them are dug out of the ſame *Mines*, and are of the ſame colour; but more eſpecially, becauſe they agree and correſpond in their *Fibres* and *Pores*: For the *ſtriate matter* finds a free paſſage through both of them, much in the ſame manner, as it doth through the midſt of the *Earth*, which it cannot do through any other *Body*. Hence *Iron* is ſaid to *cheriſh* and *ſtrengthen the Virtue and Life of the Loadſtone*, much in the ſame manner, as the *water* and *virtue* of *Fountains*, is preſerved by conveniently diſpoſed Channels for it to paſs through.

VIII. *Why Steel becomes ſofter by being cooled leiſurely and by degrees.* *Steel* that is made by fuſion in a vehement *Fire*, becomes ſofter if it be made *red hot* again, and afterwards cooled by degrees.

The Reaſon is, becauſe when it is thus cooled, the *cornerd* and *rugged Particles* of it, which by the force of the *heat* were driven from the *ſurfaces* of the Clots of it to the more inward parts, begin to appear outward, and entangling together, do as it were with little *Hooks*, joyn the Clots of the *Steel* together: By which means it happens, that theſe *Particles* are no longer ſo cloſely joyned to their Clots, nor do the Clots any longer ſo immediately touch one another, but do only hang together as it were by *Hooks* or *Links*; and conſequently the *Steel* is not very hard and ſtiff, nor brittle, but ſoft and flexible. In which reſpect it doth not differ from the common *Iron*, ſave only in this, that when *Steel* is made *red hot* a 2*d* time, and afterwards ſuddainly quenched, its former hardneſs and ſtiffneſs is reſtored, whereas by the ſame means, the ſame is not performed in *Iron*.

IX. *What is the reaſon that Wood in ſome Pools is changed into Iron.* Some *Hiſtorians* tell us, that *Wood* by being put into ſome *Pools*, becomes turned into *Iron*. Thus MAGINUS tells us of a *Pool* in *Ireland*, into which if a *Stake* be thruſt, that part which is covered with the *Mud* becomes changed into *Iron*, and the other that is covered with *Water*, into *Stone*.

The Reaſon of this is, becauſe the *Wood* by being long buried in the *Mud*, becomes penetrated by a *Metallick ſteam*, which inſinuating it ſelf betwixt the *Fibres* of it, becomes one *Body* with it, and filling up all its *Pores* by degrees, at laſt communicates to it the hardneſs and appearance of *Iron*.

X. *How Bones and Wood are sometimes changed into Stone.* In like manner, *Bones* and *pieces* of *Wood* are changed into *Stone*. Thus many *Bones* are to be seen at *Rome*, *Amsterdam* and in other places which have been turned into *Stone*. Thus pieces of *Wood* have sometime since been taken up at *Aquasparta* in *Italy*, which seem to be nothing else, but the fragments of *Stakes*, which having for a long time been covered with the *Earth*, have been so penetrated by a *Bituminous* and *Sulphureous Steam*, and grown to that Stony hardness, as to be no longer capable of being cleft. Thus likewise *Cockle-shells* are turned into *Stone*, by being fill'd with such a kind of *Petrifying Juice*, which in time reduceth them to the hardness and consistence of *Stones*. For the same *Cockle-shells* that abound on the *Sea-shoar*, have been often found far from the *Sea* on *High Mountains*. Thus in the *Guerinean Cavern* or *Grotto*, *Leaves* of *Oak*, *Holm*, *Alder*, *Poplar*, *Bay*, *Ivy* and other *Trees* have been found turn'd into *stone*, by means of a *Petrifying Humour*.

XI. *Why Steel is more stiff and brittle than Iron.* *Steel* is more stiff and hard than *Iron*, and hath a greater force to leap back, than any other *Metal*.

The Reason is, because the parts of *Steel* are not joyn'd together with entangling *Branches*, as those of *Lead* are; but by a multiplicity of *surfaces* lying one upon another like *Glass*, which is the reason that when *Steel* is bent, the ranging of its Parts is not changed, but only the figure of its *pores*; upon the change whereof, the force of the *Body* running against them is increased. And by this means the *Steel-Spring* of a *Watch* is of great use to the performing of all the *motions* of it. And for the same Reason, *Steel* must needs be more *brittle* than *Iron*, because the Drops whereof it is composed, are only joyn'd together by the contact of their *surfaces*, which, like the parts of *Glass*, only touch one another in a few *Points*, and must therefore be somewhat Brittle.

XII. *How Iron may be preserved from Rust.* For the cleansing of *Iron* from *Rust*, *Cerussa*-*Plaister*, and other such like, are commonly made use of; but there is nothing that takes it away better or more speedily, than *Oil of Tartar*, which presently looseth the *Rust*, and is then easily wiped off. And to prevent *Iron* from Rusting, there is nothing better than to besmear it with the *Marrow* of a *Deer*, or with *Oil*, which by obstructing the *pores* by their clammy Matter, hinder any watry Moisture from entring into, or Steams from coming out of them.

CHAP. VIII.

Of the various Generation of Stones.

I. *Stones are generated of Sand or Clay.* ALL *Stones* have their Rise either from *Sand* or *Clay*; and that either from *Sand dissolved*, or *Sand consolidated*.

Stones are generated of dissolved Sand, when any quantity thereof becomes coagulated; whence therefore proceeds a *Stone*, transparent like a grain of *Sand*, and of a different *figure*, as it is variously compressed by its Neighbouring *Bodies*: So some *Precious Stones* are found of no distinct *shape* or *figure*, and others that have 6 sides or *surfaces*. Again, *Stones* are generated of *consolidated Sand*, that is, when a great number of the *grains* of *Sand* do grow together, by means of *Steams* or *Exhalations* filling the Intervals between them, and joyning them together; and therefore these *Stones* are opake or dark, and rugged, by means of many Prominences, and therefore may be made use of for the sharpning of *Stones*. It may be also added, that *Stones* may be made of *Clay*, which by the admission of some *petrifying Exhalations* may become *Stone*.

II. *Whence it it that some Stones are found in* Provence *in* France, *of the figure of a Lozenge, or Quarry of Glass.* There is a sort of *Stones* found in *Provence* in *France*, whereof some are *Red*, and others transparent like *Crystal*, and of the *figure* of a *Lozenge*, which when they are broken, fall into parts of the same *figure*, tho' subdivided never so often.

The Reason of this is to be attributed, to the more perfect and elaborate disposition of the *Matter* whereof these *Stones* are generated, which is so regularly distributed, that every one of its least *particles* bestow their own *figure* upon the whole, and upon the lesser, as well as greater parts of it. We must therefore suppose, that in the first formation of these *Stones*, some *particles* of the *petrifying Juice*, were by the force of *Heat* stretched out in length, to which others joyning themselves, did by degrees constitute some small *Tables*, to which others afterwards were joyned, lying athwart them, so that the *Angles* somewhat resembled those of *Talk* or *Iznglass*. As we find that in the *formation* of *Salts* their *basis* is of a square *figure*. Thus the *particles* of *Sal-Gem* are of a square *figure* like a *Dice*, and breaks into Bits of the same *figure*; and after the same manner, and for the same Reason, do these *Stones* beforementioned break into bits that express the *figure* of *Lozenges*, and tho' broke never so small, retain the same *figure* inviolably.

III. *What is the Cause of those Glassy-Stones that are sometimes found in the Earth.* Sometimes *Glassy-stones* are found in the *Earth*, which do equal others in *weight*, as well as *hardness*; save only that they are brittle like *Glass*, and are easily broke to pieces.

The Original of these *Stones* must be attributed to *Sand*, which being melted by a most vehement *fire*, and afterwards cooled, become as *hard as Stone*. After the same manner as the *particles* of *Ashes*, when agitated by a most vehement *fire*, have their Ruggedness pared off, and become smooth, and sticking together constitute *Glass*. Thus it sometimes happens, that after great *Burnings* of the *Earth*, many of these *Glassy-stones* are digg'd forth from the *Bowels* of it, which are of different *shapes* and *figures*, according to the variety of those places into which the melted *Salt* lighted. PLINY is of Opinion, that the making of *Glass* was first found out by a Casual melting of *Sand* and *Nitre*: *It is reported*, saith he, *that a Merchant's Ship, laden with* Nitre, *being arrived, when the Ships Company were about to prepare a Feast upon the Shoar, and wanted Stones to fix their Kettles upon, they took great lumps of Salt-Peter out of the Ship for that purpose, which catching fire, and being mingled with the Sand of the shoar, made transparent Rivulets of Liquid Glass to run down.* Book 36. Chap. 20.

IV. *How Stones are generated in the Body of Man.* *Stones* are generated in the *Body of Man*, differing in bigness as well as hardness: For some of them are easily crumbled to *pouder*, whereas others are hard, and cannot easily be dissolved.

The Original of *Stones*, that are formed in the *Kidneys*, or in the *Bladder*, is the same with those that

that are generated in the *Earth*, *viz.* when by reaſon of the obſtruction of the *pores*, the *grains* of *Sand* are lockt in, and at laſt growing together, do conſtitute a hard *Body*. For it is certain, that the *Blood* and *Urine* are ſtrained, and do carry along with them the *particles* of *Terreſtrial Bodies*, which are endued with ſuch *figures*, as that when the *Blood* or *Urine* are more ſlowly moved in the *Reins* or *Bladder*, they grow into a *Stone*. For the *Sand* or *Gravel* which is generated in the *Body* of *Man*, have very uneven and rough *ſurfaces*, by means whereof they are eaſily entangled together, and conſtitute a maſs or lump of *Stone*. And this is the Reaſon why they are diſcharged out of the *Body of Man* with ſuch extream pain; for being carried with the *Urine*, and hitting againſt the *Membrans* with their ſharp Corners, they rend and tear them.

V. *Why Women are leſs troubled with the Stone, than Men.*

Women are leſs troubled with the *Stone* than *Men*, becauſe they can diſcharge the peccant Matter with greater eaſe than they, by reaſon of the wideneſs of the *Paſſages* through which it is to paſs, as alſo becauſe they are both ſtraiter and ſhorter, their *Terms* alſo being beneficial to them in this caſe. Moreover it is obſerved, that *Fat* and *Purſy perſons* are moſt troubled with this *Diſeaſe*, becauſe ſuch *Bodies* abound with *Earthy dregs* and *volatile acids*; as alſo, for that by reaſon of the bulk and weight of their *Body*, they are fain to live an idle and ſedentary *Life*, which alone contributes not a little to the forming of this *Diſeaſe*.

VI. *Some ſuppoſe that Stones are generated in the Body of Man, by a petrifying Spirit.*

Some ſuppoſe that there is a *Petrifying Spirit* in the *Body of Man*, which is the Cauſe of this generation of *Stones*, more eſpecially in the *pores* of the *Kidneys* and *Bladder*, which tranſmutes the dreggy and thicker parts of the *Blood* into *Stone*, to which formation that *Volatile Salt*, which is hid in the *Stone*, and drawn thence by *Chimiſtry*, doth not a little contribute; for by means of theſe *ſaline Volatile particles*, the thicker parts of the *Blood* are joyned together. Now that there is ſuch a *Petrifying Spirit* in *Nature*, may be proved from many *Springs*, which turn all the things that are caſt into them into *Stone*; ſuch as is that *Spring* which is near *Bergen* in *Norway*, and many others elſewhere. And therefore ſome think, that the like *ſpirit* may lye hid in the *Bodies of Men*, ſeeing that it is evident beyond contradiction, that a *ſpirit* not much unlike this is found in it, which changeth the parts of the *Chyle* into *Bones*, *Griſtles*, *&c.*

VII. *Sometimes the Kidneys themſelves, yea, and whole Infants in the Womb, have been turned into Stone.*

That *Stones* in the *Bodies of Men* do ſometimes grow to a great bulk, is teſtified by ISRAEL, a *Profeſſour* of *Heidelberg*, who ſays, that a *Woman* had a *Kidney* cut out of her *Body*, that was wholly turned to *ſtone*: Yea, what is far more ſtrange, he tells us, that a whole and entire *Birth*, compleat and formed in all his parts, and which the *Mother* had carried in her *Body* no leſs than 28 years, was after her Death found as hard as *Marble*, and taken out of her *Body*. Which wonderful Effect cannot be aſcribed to any thing elſe, but this *Petrifying* or *Volatile acid Spirit*, which is always endued with a great virtue of *acting*, *figuring*, and *congealing*: For the ſwiftneſs of this *ſpirit* doth readily paſs through all *pores*, and clinging to them, makes the *Body* to become harder, much like *Coral*, which being taken out of the bottom of the *Sea*, is hardned by the *Volatile Acid* which is lodged in the *Air*, and becomes *ſtony*.

VIII. *The Stone is often Hereditary.*

The *Diſeaſe* of the *Stone* is frequently conveyed from *Parents* to their *Children*; for ſeeing that the *Particles* whereof the *Stone* is formed, owe much of their tendency towards the producing of this *Diſeaſe*, to the *Texture* of the *Fibres* through which they are ſtrained; and that the ſame depends on the firſt forming of the *Parts of the Body*, which proceeds from the *Parents*, this *Diſeaſe* may very well be ſaid to be traduced by them to their Poſterity.

IX. *Of a Stone which lies ſtill in Freſh-water; but being put into Vinegar moves up and down.*

MERSENNUS makes mention of a *Stone*, which being caſt into *Freſh-water* lies quiet; but when put into *Vinegar*, or *Spirit of Vitriol*, is moved; and more in *Spirit of Vitriol*, than in *Vinegar*.

The Reaſon of this may be ſuppoſed to be, becauſe this *Stone* is full of *pores*, which do readily admit the *particles* of *Vinegar* and *Spirit of Vitriol*; but are not fitted to receive the *particles* of *Freſh-water*. So that *Particles* of *Vinegar* entring the *pores* of this *Stone*, drive out the *particles* of the *Air* or *Water*, which dilating themſelves at their coming forth, do lift up and agitate the ſame.

X. *Whether it be true that Stone is turned into Wood, not far from* Rome

Some *Hiſtorians* tell us, that there are certain *Quarries* of *Stone* near *Rome*, the *ſtones* whereof are changed into *wood*.

But I ſhould be much more apt to believe, that theſe *Stones* are not changed into the *ſubſtance* of *Wood*, but only repreſent the outward appearance of it. Much in the ſame manner as that *Vein* of *Stones* which is found at *Novigentum*, on the River *Sein*, do imitate the *figures* of certain *Plants* and *Trees*.

XI. *Of a Stone that being caſt into the water, changeth its colour.*

There is a certain *Stone* as white as *Alabaſter*, by ſome called the *Eye of the World*, which being for ſome time ſuffer'd to lye in the *water*, doth not only become more *heavy*, but likewiſe grows tranſparent, and receives a new *Colour*.

The Reaſon is, becauſe the *Liquor* that enters into the *pores* of this *Stone*, doth more dilate and diffuſe the *Light*, and refracts the *Rays* much in the ſame manner as the *grains* of *Sand* might do. For it cannot be doubted, but that this *Stone* hath many pellucid *particles*, and that the *Air* which is got into the *pores*, being thruſt out by the *particles* of the *water*, make the *ſtone* to loſe its tranſparency, and to be changed into a *white Colour*; for as ſoon as the *Stone* is dried, it loſeth its *white Colour*, and becomes tranſparent, as before.

XII. *How the Stones are produc'd, which are found at the bottom of Rivers.*

Stones are frequently generated in *Rivers*; yea, it hath been found that the whole bottoms of ſome *Rivers* have been changed into *ſtone*. PATRITIUS tells us, that whilſt he ſtudied at *Avignon*, he frequently went to *ſwim*, in the leſſer Arm or branch of the River *Rhone*, and that he found that the Bottom, which he had known before to be ſoft and ſmooth, was all cover'd with *ſtone*.

The Cauſe of this Change might be from the *Earthquake*, which ſometime before hapned about the *ſhut-up Valley*, ſo called. For the *Earthquake* might probably caſt up a great heap of *Sand*, which being conveyed from the River *Sorga* into the leſſer Channel of the River *Rhone*, and ſetling there, might grow into a great multiplicity of *Stones*. And this Conjecture ſeems the more probable; becauſe thoſe who frequent the the River *Rhone* and *Druent*, aſſure us, that they very often found at the Bottom of them, *Horſes-ſhoes*,

ſhoes, *Nails*, and other *Iron-work*, to which the *Sands* did ſtick ſo cloſe, and were grown ſo thick about them, that they were wholly cover'd with a Cruſt of *Stone*, by the coalition or growing together of the ſaid *Sands* upon the *Iron*.

XIII. *Whence thoſe Stones proceed, which are found on the ſurface of the Ground.*

Great abundance of *Stones* are frequently found in *Fields*, that are in all reſpects like to thoſe that we meet with at the bottom of *Rivers*; being of the ſame *bulk* and *figure*, ſomewhat *Oval*, and inclining to a round *figure*.

It is probable, that theſe *Stones* were carried by the force of *waters* from the Tops of *Mountains* to the *Fields* that lye under them, or elſe by the overflowing of the *Rivers*. For it is apparent that the *Stones* which are ſcattered up and down the *Fields* of *Crautia*, come from the overflowings of the Rivers *Rhone* and *Druent*, which left *Mud* and *Sand* enough behind them, for the forming of the ſaid *Stones*. For all the *Stones* that are found there are not equal, but different in *bulk*, tho' not in *figure*: For thoſe that are about the midſt are *bigger* than the reſt, and are leſſened as they withdraw from it; and thoſe are leaſt of all that are towards the Extream parts; becauſe the fore-mentioned two *Rivers* having ſtagnated there for a good while, more *Sand* was gathered about the midſt, than about the other more remote and outward parts. And that this was the true Cauſe of the generation of theſe *Stones* may be gather'd from hence, that thoſe *Plains*, which are far remote from any *Mountains*, are deſtitute of theſe *Stones*, there being not ſo much as the leaſt footſteps of them to be ſeen.

XIV. *What is the cauſe of thoſe Shells that are found near* Briſtol.

In ſome places not far from the City of *Briſtol*, are found the *ſhells* of *Fiſhes* of a different *colour* and *form*; for ſome of them are twirl'd about like the *Tendrils* of a *Vine*; others, otherwiſe.

As to the *Original* of theſe, it ſeems moſt probable, that they are not the effect of any *Juice* or *Moiſture*, but were brought thither either by means of an *Earthquake*, or an *Inundation*; or by the entrance of ſome foreign Matter into their *pores*, which ſticking there hath rendred them *hard* and *ſtony*.

XV. *What is the Cauſe of thoſe Stones which are found in Springs.*

Stones are likewiſe found to be generated in *Springs*; yea, ſometimes the Bottom of them is ſo full of *Stones*, that they riſe much higher than they were formerly. GASSENDUS makes mention of a *Fountain* of *Dinia*, which covers all the *Channels* it runs through with a *Stony Cruſt*.

The Cauſe which generates *Stones* in *Springs*, is this: The *Waters* that conſtitute theſe *Fountains*, running through *Rocks*, do carry ſome *particles* of them along to the ſaid *Spring*; which being no longer ſwiftly agitated, as they were when they were when they paſſed through the *Rocks*, begin to ſettle and grow together. And that ſome *Waters* in their paſſage through *Rocks*, are impregnated with *Stony particles*, may be proved from that *Fountain* which is at *Rome*, which hath ſo covered all the ſides of the *Pipe* that it runs through, that it hath long ſince been quite ſtopt with a kind of *Alabaſter*. And the ſame happens in a *Grotto* near the City *Tours* in *France*, where the Drops of *Water* dropping down, are turned to *Stone*.

XVI. *New Stones are formed daily.*

Wherefore we may conclude with *Peireskius*, that all *Stones* were not created at the Beginning of the *World*; but that many are formed in proceſs of time, as owing their original to certain proper *Seeds*, but their configuration, partly to *Nature*, and partly to *chance*. For ſeeing that a *petrifying Seed* is found in ſeveral places, when the ſame is received into any *Liquor*, it immediately coagulates the ſame, as Rennet doth *milk*, and imparts a ſpecial form to it.

XVII. *Why Flints are for the moſt part of a roundiſh figure.*

Flints are for the moſt part of a round *figure* or approaching to it.

The Reaſon is, becauſe the *ſurface* or outward part of the *Earth* abounding with many *Slits*, it cannot be, but that the *Air* which circulates continually in them, muſt force the parts of *Flints*, to range themſelves into a round *figure*, becauſe by this means they do leſs hinder or obſtruct its motion.

CHAP. IX.

Of Pearls and precious Stones.

I. *Why precious Stones and Pearls have the ſame figure.*

GEMS and *Pearls* are commonly called *Stones*, but with addition of the *Epithet Precious*, becauſe they are highly valued, and not acquired without great labor, or high price. *Precious Stones* agree with *Pearls* in this, that they have all the ſame *Figure*, and tho' they be the product of ſeveral places, yet are never of a different form.

The Reaſon is, becauſe *Pearls* are generated in *Shells*, that are ſo ſmooth and poliſht that they ſhine, which Politeneſs the *Stones*, that are *generated* in them do partake of. For *Pearls* in their firſt riſe are a kind of ſwellings like *Warts*, or excreſcences proceeding from the matter of the ſaid *Shells*, which in progreſs of time become *Pearls*. But *Gems* owe their *generation* to certain exactly percolated *Juices*, which being only in ſmall quantity, every drop of them conſtitutes a particular *Gem*, and cannot be encreaſed to a greater number, but by the occaſion of more of theſe drops. And tho' it may be, they may differ in bulk, yet becauſe the action of the *ſubtil matter* is the ſame in them all, they are all of them partakers of an uniform *figure*.

II. *Various precious Stones have various figures.*

Hence it is that all *Cryſtal* is 6 cornerd, *Emralds* 12 cornerd, *Diamants* and *Rubies* 8 cornerd, and ſo for the reſt: Becauſe in their coagulation they are ſplit, and multiplied like the *Grains* of an *Ear* of *Corn*, within the ſame ſheath or hull, and that by reaſon of their *ſpecial Seeds*, according to which Stones obtain as conſtant *Configurations*, as either *Plants* or *Animals*. Thus we ſee that *Jaſpis Stones*, *Porphyry* and *Marble* are naturally ſtreak'd and embelliſht with various *colours*, waved through one another. And a *Nutmeg* in divers colours, repreſents the winding turnings of the ſubſtance of the *Brain*. And the ſame may be obſerved in the *Oak*, *Walnut* and other *Trees*, which being ſawn into *Boards*, and plained, exhibit a pleaſing Labyrinth of multifariouſly windings *Veins*.

III. *Whence the variety of colours that is in precious Stones doth proceed.*

Almoſt all *precious Stones* do differ in *colour*, for ſome of them are *perſpicuous*, others are in a great meaſure *Opake*; neither do thoſe that are Tranſparent agree in all things. For the *Carbuncle*

buncle is of a *Purple Colour*, an *Emrald* Green; a *Saphire* Blue, a *Jacinth* of a Fiery Yellow, an *Amethyst* of a Violet Colour, an *Opal*, various, *&c.*

Precious Stones are *Transparent*, when the Steams and *Vapours* whereof the *Juices* consist, are not congealed till their slippery and fluid *particles* be exhaled, so as that the *Globuli* of the *2d Element* can readily pass, and convey the *action* of Light through them. And on the other hand they become *Opake* or Dusky, when the said Steams are stopt in some narrow Crevices of the *Earth*, and become there so entangled with several *Terrestrial Particles*, that the *Globuli* of the *2d Element* can have no passage through them. The reason why some *Precious Stones* are adorned with several *Colours*, proceeds from the various mixture of *Metalline Particles*, which variously reflect the Light, and differently affect our *Eyes*. This is evident from the mixture of *Wine* and *Water*, where the *Colours* of both are so confounded, that the *Water* espouseth the *Redness* of the *Wine*, and the *Wine* embraceth the *Paleness* of the *Water*.

IV. *This variety of Colours in Precious Stones, proceeds from the various mixture of Metallick Particles.*

For we observe that *coloured Gems* are, for the most part, found in *Mineral Veins*, or near to them; and sometimes amongst the very *Oar* of *Metals*. Thus it is notorious, that *Granates* are found in the *Iron Mines* of *Norway*. And Mr. BOYLE assures us, that *Amethysts* are drawn out of *Iron* and *Tin Mines*. And those who have visited the *Copper Mines* of *Hungary* tell us, that besides the *Vitriolick Water*, which changeth *Iron* into *Copper*, there is found another *White Water* which changeth the remainder into a hard and white *Stone*: But if before its coagulation it pass through a *Copper Mine*, then it produceth a *Stone* called *Malochis*, of a *Blue Colour*, which Colour would be *Brighter*, and of the *Tincture* of a *Turkois*, in case this petrifying Juice should happen to pass through a *Mine*, wherein it meets with any *Silver Oar*. From all which it appears highly probable, that the *Colour* of *Gems* proceeds from the mixture of *Metallick Particles*.

V. *What is the Cause of those Spots that appear in some Precious Stones.*

Stains do arise in some *Gems*, and *Spots* in others, as in the *Agat*, &c.

The Reason is, because the *juice*, whereof they are formed, is gathered together in some receptacles, as it were in a *Matrix*, and there rests for some time before it is coagulated, by which means, any thing of impurity contain'd in it, doth by degrees sink to the bottom. But if the *Juices* be congealed before that the *Heterogeneous* parts be sunk to the bottom, and united into one *Mass*, the *Precious Stones* become blemished with several *Spots*, or Streaks; thus *Flies*, *Pismires* and other *Insects* are found sometimes in *Crystal*, because falling into the *Petrifying Juice*, the same was coagulated into a hard lump, before they had time to settle to the bottom. Yea, *Historians* tell us, that a *Serpent* has been found in the midst of a *Stone*, and a live *Toad* in the midst of another, without the least footstep of any passage through which the *Animal* might have entred.

VI. *Amber is a matter that is dug out of the Ground.*

From hence we may infer, how fabulous it is what some *Authors* relate of *Amber*, that there are some very high *Trees* in *Norway*, from whence it *distils* in the form of a *Gum*, and that falling down, it becomes hard. Seeing that it is well known, that *Amber* is dug out of the *Earth* in *Sicily*, Which may be farther confirmed from the *Flies* and other *Insects* that are found in it. And whereas abundance of *Amber* is taken up in the *Baltick Sea*, we must conclude the same to have been carried thither by the force of the Waves, which often driveth it to the Shoar, where it is frequently found.

VII. *Crystal is frequently found in Mountains.*

Crystal is found in *Mountains*, especially those which are continually covered with *Snow*, and where the most intense Cold bears sway.

The *Antients* were of opinion, that *Crystal* was *generated* of *Frost* and *Snow*, or as others, that it was nothing but *water*, congealed to that degree of Hardness, by extream *Cold*. And accordingly SENECA expresseth himself thus concerning the Generation of *Crystal*, *The Heavenly Water, that hath little or nothing of Earthly Feculence mixt with it, being once congealed, by the obstinate continuance of Frost, grows still harder and harder; till that all the Air being excluded, it become most closely compress in it self; so that that which before was Water, is now become a hard Stone. In the 3d Book of his Natural Questions.* But we have many *Arguments* to prove this a mistake. *First*, Because *Crystal* doth not melt when it is set to the *Fire*; neither is any thing diminished by the most intense *heat*, which yet is the Property of all moisture, that is coagulated by Cold only. Again, if *Crystal* owes its original to *Snow Frozen* to such a degree of *Hardness*, how comes it to pass, that *Fire*, by a strong *Rubbing* may be struck out of it? Who ever could strike *Fire* out of a piece of *Ice*, as it may be out of *Crystal*? Lastly, if places abounding and covered with *Snow*, do favour the rise and growth of *Crystal*, why is it not found in those *Mountains* where the *Snow* is *perpetual*, and where the *Cold* never suffers intermission?

VIII. *The Generation of Crystal is much like that of Sand.*

Conclude we therefore, that *Crystal*, as well as other *Gems*, is the effect of a strained petrifying *Juice*, and that the same derives its difference in Transparency and Hardness, from the diversity of the matter whereof it consists. We have great reason to believe this, because we find that *Artificial Crystal* is the product of *Sand melted* by the help of *Salts*. And tho' sometimes *Crystal* be found in *Rocks*, as if it were something produced by them; yet is this only to be ascribed to this *Petrifying Juice*, which falling into the Chinks of *Rocks*, becomes there congealed, in the form of falling drops.

IX. *Why the Bottom of Precious Stones is somewhat dusky and dark.*

From what hath been said, we may understand the reason why *Precious Stones* have a thick and dark *ground*: For seeing that the clear *Liquor* whereof they are formed, doth for some time rest in their peculiar *Vessel* or *Womb*, it must needs happen, that whatsoever is impure in the said *Liquor*, must sink to the bottom; and this makes the ground of them more dull and dark than the other parts of them.

X. *Precious Stones are formed of a clear Liquor.*

Now it is apparent, that not only *Crystal* but *Diamonds* and *Amethysts* derive their original from a *Limpid Liquor*. But yet we must not *imagin*, that when they are coagulated, the entire *Liquor* grows into one *Lump* or *Mass*, but that they are all by slits divided into several *Stones*; and like the many *Grains* in an ear of Corn are multiplied within the same *Sheath*; so as that according to the peculiar nature of the *Seed*, they are

formed into a different *Figure*, as was mentioned before.

XI. *Whether a Diamond cannot be hurt by Fire, and yields only to the Blood of a Goat, by means whereof it may be reduced to Powder.*

The common or vulgar opinion concerning the *Diamond* is, that it is of an insuperable Hardness, which doth not in the least yield to any *Iron Instrument*, *Hammer* or *Anvil*: No not to the force of *Fire* it self; for tho' being cast into the most violent hot *Furnace*, it never so much as grows hot; and yet is reduced to *powder*, by the newly shed hot *Blood* of a *Goat*.

These particulars, tho' commonly received, are by experience found to be false; for it is certain that a *Diamond* yields both to the force of *Fire* and *Iron*. Thus BODINUS assures us in his *2d Book of Nature*, that a *Diamond* may with a *Hammer* be reduced to *dust*, and ground to *powder* with an *Iron Pestel*. The *Fire* also masters it, for by a continual flame it is reduced to a *Calx*. Neither is that common report truer than all the rest, that if the Powder of it be taken inwardly, it procures the *Bloody Flux*, since it is certain, that some *Servants*, to hide their *Stealth*, have swallowed whole *Diamonds*, and without the least impairing of their *Healths*, have voided them again. Yea, The *Powder* of it hath been given inwardly to the quantity of a whole *dram*, without prejudicing the Health of the Taker, any more than if he had eaten so much *Bread*. *Cardan. 2d Book Tract. 5. Contrad. 9.*

XII. *The Electrick Virtue in Diamonds is changeable.*

The *Electrick Virtue* in the *Diamond* is not always unchangeably one and the same. For Mr. BOYLE hath observed concerning a *Diamond* of his own, that this *Electrick Virtue* was frequently changed, being at some times much more strong, than at others.

The Reason is, for that a *Diamond*, tho' it be a *Solid Body*, and that its parts do seem very closely compacted, yet are not they altogether free from some inward motions; it being very probable that there are no *Bodies* so solid, but that their parts are more or less partakers of some *motion*. Now supposing this intestine motion in *Bodies*, it cannot seem strange, that upon the changing of the Texture of their *parts*, their *virtue* should be changed also. Besides the changes of *Colour* that are observed in a *Diamond*, are an evident proof of the motion of its parts; because being rubb'd, it *shines* and *sparkles* much more bright and briskly at one time than at another; which change cannot be without motion.

XIII. *What is the Reason of the Sparkling Brightness of a Diamond.*

A *Diamond sparkles* the brighteſt of all other *Precious Stones*, and striks the Eye with the most brisk and dazling splendor.

The Reason is, because it consists of a most pure *Juice*, whose parts are so divided by straining, that they Reflect and Refract the *Rays* they have received from all sides of them. For all the *particles* of it are as so many *Looking-Glasses*, which reverberate the light after the same manner as they receive it. This effect may also be ascribed to the *Tincture*, whereof it is capable in a high degree, not because of any connate likeness, as some suppose; but because such is the disposition and situation of its parts, that all the strokes of the *Tincture* do appositely agree together, and take up all the *Pores* of it; which how much it doth conduce to the *Reflexion* of the *Rays* of light, those who are any thing versed in *Opticks*, cannot be ignorant of.

XIV. *Precious Stones do not always afford the same appearance.*

Mr. BOYLE makes mention of a *Turcois*, which frequently changed its *Colour*, and afforded a different representation to the *Eye*. For after that it had caused a *Painter* to express most exactly the *Colour* of it, he found that at other times, it not only appeared to him variously from what it appeared when the *Painter* took a draft of it, but also perceived several *Spots* in it, which continually had shifted their places.

All this must certainly be attributed to that *Intestine Motion* which is in the parts, even of the most *solid Bodies*. Tho' indeed this motion be imperceptible, and not subject to our *Sight*. For what other reason can be assigned why the *Stones* whereof *Houses* are *built*, grow harder in process of time, except we allow this motion of their parts, whereby they come closer together? Mr. BOYLE hath also observed the vanishing of a *Spot* that was in an *Agate*, and that the *Electrical* and *Radiant Virtue* is not always the same in a *Diamond*, but is at sometimes much more strong and brisk, than at others; which is a sufficient proof, that the parts of the most *solid Bodies* are not altogether exempt from motion.

XV. *Whether there be any Medicinal Virtue in Precious Stones.*

Very considerable *Physical Virtues* are attributed to some *Precious Stones*, whereby not only outward hurts, but many and great inward Diseases are cured.

It cannot be denyed, but that many things which are commonly reported concerning the Virtues of *Precious Stones*, sound little better than *Fables*. But in case they have any such, which I would not absolutely deny, because it is a thing unanimously attested by many very Learned and Famous Men, they must proceed from some *Mineral Juices* that are mingled with the matter of the *Precious Stones*, whilst they are yet *fluid*. And that such *Juices* do mingle with them, is evident from hence, because they may sometimes be separated from them, as we see they may in *Granates*; and for that they frequently encrease the specifick weight of *Gems*, and endue them with various *Tinctures*. For seeing that such penetrating *Effluvia* proceed from the hard *Loadstone*, and that *Precious Stones* are endued with an *Electrical Virtue*, it cannot be questioned, but that many thin and *subtil steams* do proceed from *Precious Stones*. Again, what a vast number of *Minerals* and *Metals* are there in the *Bowels* of the *Earth*, which may be coagulated with petrifying *Juices*, and unite themselves with the same before their coagulation; and being so united, may exert greater *Virtues* than are to be found in *Minerals* that are melted in the *Fire*, or dissolved in *Stigian Waters*, and by means whereof *Precious Stones* may dry, adstringe, consolidate, and produce many other effects.

XVI. *Why Coral, which is soft under Water, grows hard as soon as it comes to the Air.*

Coral that grows under the *Sea-water*, in the manner of a *Shrub*, and is soft whilst it continues there, as soon as it is brought up into the *Air*, becomes hard, and loseth its former softness.

Supposing this to be true, the Reason may be, that *Coral* as long as it lies hid under the *Sea-water*, doth abound with much *Salt*; but when taken up thence into the *Air*, it grows hard and solid by the exhaling of its *moisture*. For the *fluid particles* of *moisture*, that lie lurking in the *pores* of *Bodies*, do dilate them, and shake the other parts of them by their motion, which is the proper cause

G. Freman. In. I. Kip.

To Leivtenant Collonell Wheler of Datchet Bucks, one of the first Regiment

Andrew Pitcarne alias in the County of Captains of their Maties of foot Guards.

This Plate is humbly Dedicated by Richard Blome.

cauſe of the ſoftneſs of thoſe *Bodies*; but as ſoon as theſe *fluid particles* are evaporated, the remainders are more cloſely joined together. Thus young and tender *Plants*, becauſe of the great abundance of *Moiſture* and *Salt*, which diſtend their parts, are eaſily bent or *ſlit*, but when they are old, they grow hard, becauſe of the exhalation of their *moiſture*, and the *Air* entring, inſtead thereof, are much ſooner broken, than bended or ſlit. Thus PETER PELLEPRAT tells us of a certain kind of *Clay*, which is found not far from the mouth of the *River* of the *Amazons*, which as long as it is covered with the Waves, is ſoft; but as ſoon as it toucheth the *Air*, grows ſo hard, that the Inhabitant *Savages* uſed in former times to make their Hatchets of it.

XVII. *Coral is not ſoft whilſt it is under water.*

But when I conſider that *Coral* is of a *Mineral Nature*, and a kind of *Precious Stone*, I am more apt to believe, that it is the product of ſome *Glutinous Juice*, which being turned into Stone by the binding Virtue of *Salt*, wherewith it abounds, ſprings up like a Shrub. For *Salt* conduceth very much to the encreaſe of *Plants*, and is that which cauſeth them to ſpread into Sprigs and Branches. And *Signior Paulo Boccone* witneſſeth himſelf to have experienced as much, who being preſent, when ſome were *fiſhing* for *Coral* at *Meſſina* in *Sicily*, he put his Hand into the *net* before it was drawn out of the *water*, and found the *Coral* to be hard.

CHAP. X.

Of the Magnet or Loadſtone.

I. *Why a Loadſtone points towards the North Pole.*

IF a *Loadſtone* be hung up in the *Air*, or be ſuffered to *ſwim* on the top of *Quickſilver*, it will wave this way and that way, till one of its *Poles* look towards the *North*, and the other towards the *South*: Yet not altogether in an even *Horizontal Situation*, but ſo as that that part which points to the *North*, will be depreſt beneath the Level of the *Horizon*, to the end it may the better be directed towards the *Northern Pole* of the *Earth*.

The Reaſon of this Converſion muſt be fetch'd from the *ſtriate matter*, whence the *Magnet* receives all its *virtue*; the *particles* whereof are ſo twiſted, that thoſe which proceed from the *South Pole*, cannot enter in at the oppoſite *Northern Pole*; and therefore ruſhing obliquely into the *pores* of the *Loadſtone*, ſwimming in the *Quickſilver*, they do by the force they have, drive them to continue their motion according to *Right Lines*. And by this means it comes to paſs, that the *Magnet*, after ſome *motions* this and that way, returns to its natural ſtate. So that being left to its liberty, the *South Pole* of the *Magnet* tends to the *North Pole* of the *Earth*, and the *North* to the *South*; becauſe the *ſtriate matter*, which paſſeth from the *North Pole* of the *Earth*, and takes its courſe through the *Air*, towards the *South*, comes firſt from the *South* part of *Heaven*, through the midſt of the *Earth*; as that comes from the *Northern* part of the *Earth*, which returns to the *North*. Furthermore the reaſon why the *Loadſtone* doth not keep it ſelf in an *Horizontal Situation*, but declines towards the *North Pole* is, becauſe we live in the *North* part of the *World*, and conſequently have the *North Pole* nearer our *Horizon*, than the *South*.

II. *Why one Loadſtone approacheth to another, or withdraws from it.*

Wherefore if you apply the *North Pole* of a *Loadſtone* you hold in your hand, to the *North Pole* of another ſwimming on *Quickſilver*, or *water* with the help of a *Cork*; this latter will withdraw from the *Loadſtone* you hold in your hand, becauſe the *ſtriate matter* that proceeds from it, in taking its compaſs, doth hinder the other. But when this latter Loadſtone turns its *South Pole* to that which is immoveable in your hand, then it will approach to it; becauſe the interpoſing *Air* being driven away by the *ſtriate matter*, the *Loadſtone*, by how much the leſs reſiſtance it finds, is the more forcibly driven on by the *Air* that doth ſurround it.

III. *Arguments proving that there is a Vortex of the Magnetick Matter.*

Now that the *Magnetick matter* doth make a kind of *Vortex* about every *Loadſtone*, may be evinced by ſeveral *Arguments*. We find that the *Needle* of a *Compaſs*, is put into various *ſituations*, according as it is differently poſited about the *Loadſtone*: being placed even with the *Poles* of the *Loadſtone*, it lies in a ſtraight *line*, and makes one Line with the *Axis* of the *Loadſtone*; but is variouſly inclined when it is otherwiſe placed. Another *experiment* that makes out this, is, that if you pour out the *filings* of *Steel* upon *Paper*, having a *Loadſtone* fitly placed in the midſt of it, we ſhall find in the ſaid *filings* the plain draught and appearance of a *Vortex*. For upon the ſhaking of the *Paper*, we ſhall with pleaſure behold the *filings* of *Steel* ranging themſelves, as it were, into certain *Rings*, whereof thoſe are the largeſt which ſhall return to thoſe parts that are nearer to the *Poles*. And if afterwards another *Magnet* be laid near to the former, then thoſe *Rings* of the *Vortex* will appear under another *Figure*, to the end they may paſs now through the *Poles* of this laſt placed *Loadſtone*, in caſe that care be taken, that the *South Pole* of the one of theſe *Magnets*, be turned towards the *North Pole* of the other. Which *Experiments* demonſtrate to the *Eye*, the various *Rings* and turnings the *magnetical matter* makes about every *Loadſtone*.

IV. *When a Loadſtone is divided, its Poles are changed.*

When a *Loadſtone* is *divided* in length, its *Poles* by this means are changed, and thoſe parts of the *Fragments* or Pieces, which before this Diviſion were join'd together, and pointed to the ſame *Poles*, do now withdraw and flee from one another. For if the *Parts* A and *a* were before join'd together, and ſo likewiſe B and *b* at the other end; as ſoon as this diviſion is made, *a* will turn to B, and *b* towards A; ſo that the *North Pole* of the one doth no longer agree with the *North Pole* of the other; nor the *South* with the *South Pole*. Figure 21.

The Reaſon is, becauſe the *Southern ſtriate Particles*, which come forth through the *Northern Part* of one *Section*, muſt enter into the other through the *Southern Part*, and come forth through the *North*. Foraſmuch therefore as the *ſtriate Particles*, which come forth from the greater Fragment A B, are *Southern*, they muſt turn about the upper *piece a b*, and ſo fit and diſpoſe the ſame, as that they may freely enter through *a*, and go out again through B. For A is ſuppoſed to be the *South Pole*, by which the *Southern Particles* do enter, that come forth from the other part of the *Segment* or *Diviſion* through *b*, and which there-

fore

fore cannot enter through *b* into the upper part of the *Loadſtone*, becauſe it is *Northern*, and therefore unfit to admit the *Northern ſtriate matter*.

V. *How a Knife that hath acquired a Magnetick Virtue, by being rubbed on a Loadſtone, comes to be deprived of its Virtue.*

A *Knife* that hath been rubb'd with a *Loadſtone*, attracts *Iron* after the ſame manner as the *Magnet* it ſelf doth; but if we paſs it over the *Pole* of the *Loadſtone*, a quite contrary way, than we paſſed it at firſt, it will loſe the *virtue* of drawing *Iron*, which by the former rubbing or paſſing of it over the *Loadſtone* it had acquired.

The Reaſon hereof is, becauſe the *Knife* by being paſſed over the *Loadſtone*, or rubb'd againſt it, was become a perfect *Loadſtone*, for this reaſon only, becauſe the *magnetical matter* had opened its *Pores*, and had ſmoothed thoſe prominent little *Branches* of the *metallick particles* in the ſaid pores that before hindred their free and ready paſſage through them. And ſo in like manner it loſeth the *quality* of a *Perfect Loadſtone*, by being paſſed in a quite contrary way over the ſame *Pole* of the *Loadſtone*; becauſe the *magnetical matter*, exerts now a contrary effect upon the *Knife* to what it did before, that is, it now raiſeth again the prominent extremities of the *Branchy Particles* in the *Pores* of the *Knife*, which it had before couched, and ſmoothed.

Now that this is ſo, appears evidently from this *Experiment*, that if we lay ſome *filings* of *Steel* upon a *Paper*, as was before-mentioned, and draw or paſs a *Loadſtone* over them, we ſhall ſee that the parts of the ſaid *filings* will range themſelves one upon the top of another, and conſtitute, as it were, ſo many *Hairs*, which all of them lie one way; and if then we paſs the *Loadſtone* over them the contrary way, we ſhall find the ſaid *Hairs* to turn themſelves, and to lay themſelves a quite contrary way to what they were before.

VI. *What is the Cauſe of the Declination that is found in the Magnet.*

The *Poles* of the *Loadſtone* do not always point directly to the *Poles* of the *World*, but variouſly decline from the ſame, as may be ſeen in Dr. GILBERTS Treatiſe of the *Loadſtone*, who gives us an account of the obſervation of one Mr. BORROUGHS, who in the year 1580 at *Limehouſe* near *London*, obſerved that the *Declination* of the *Loadſtone* was 13 *degrees* and 35 *minutes*: And of Mr. GUNTER, who in the year 1622 found the ſaid *Declination* to be only of 6 *degrees*, and 13 *minutes*: And laſt of all his own obſervation, who in the year 1634, found it to be only of 4 *degrees* and 2 *minutes*.

The decreaſe of theſe *Declinations*, proceeds from the *Earths inequalities*. For it is certain that ſome places abound with *Iron Mines* more than others, and that the *Loadſtone* is not equally diſperſt in all places; but is found much more plentiful in one than another. And therefore it is that the *ſtriate particles*, which find a more free paſſage through the *Magnetical Bodies* than through any other, breaking forth from the *inward* part of the *Earth*, do flow in more abundance towards ſome places, than towards others: And by this means do frequently deviate from their courſe, and turn aſide towards other *Bodies*, through which they paſs more eaſily and readily. And foraſmuch as the turning of the *Poles* of the *Magnet*, or of the *Points* of the *Needle*, doth only depend on the courſe of thoſe *Particles*, it muſt needs point that way where there is a greater quantity of *matter*, that is proper to draw it. This is evident in any *Loadſtone* that is not of a *Round* or *Spherical Figure*: For if a ſmall *Needle* be applied to the different parts of it, it will not always turn it ſelf to the *Poles* of it in one and the ſame manner, but will frequently decline a little from them. And therefore it cannot ſeem ſtrange to us, if the *Declination* of the *Loadſtone* be changed in one and the ſame place; and that in proceſs of time its *Poles* do not exactly point to the *Poles* of the *Earth*; Becauſe this matter may ſhift its place; as for inſtance, in the *bottom* of the *Sea*, or in the *cavities* of the *Earth*; or the *Iron* may be dug out of the *Earth* in ſome parts, or be corrupted, and degenerate into another *Body*.

VII. *Magnetical Bodies are not always turned from South to North.*

Hence it appears, with how little reaſon ſome *Philoſophers* do endeavour to explain the *Declination* of the *Magnet*, by the *Deviation* of the *Little Bear*, or of the *Poles* of the *Ecliptick*, from the *Pole* of the *World*: Seeing that there be many places found, where this Declination is towards the *Weſt*, as it is generally on the *Eaſtern* ſide of the *North* part of *America*; on the *Weſtern* Coaſt of *Nova Zembla*; on the *Eaſtern* Shoar of *Africa*, and the *Weſtern* of *Goa*. Yea, in the *Azores* Iſlands, which lie betwixt *Europe* to the *Eaſt*, and *America* to the *Weſt*, it declines neither way: As in *Trinity* Iſle, at the *Promontory* of *Needles*, near to the Promontory or Cape of *Good Hope*, at *Vienna* in *Auſtria*, and other places.

VIII. *What is the Reaſon that a leſs Declination is found in a Loadſtone that is placed upright on one of its Poles.*

Some tell us that a *Spherical Loadſtone* being placed upright on one of its *Poles*, hath leſs *declination*, than when its *Poles* are at an equal diſtance from the *Earth*.

The Reaſon of this may be, becauſe the *ſtriate particles* that are in the upper part of this our *Earth*, do not only turn from one *Pole* to the other, by *Lines* that are at an equal diſtance from its *center*; but alſo becauſe every where (the *Equator* only excepted) ſome of the ſaid *particles* do aſcend from its inward parts, the *turning* of the *Magnet* ſet upright on its *Poles*, depending on theſe latter *particles*, but its declination chiefly on the former.

IX. *Iron, being touched by a Loadſtone, acquires a Magnetick Virtue.*

The *Loadſtone* communicates its *virtue* to *Iron*, and doth ſo change it with a *Touch*, as to make it point towards the *Poles* of the *World*, in the ſame manner as it ſelf doth. The famous GASSENDUS obſerves, that the *Iron Croſs*, which had been fixt a long time on the top of the *Great Church* of *Aix*, being caſt down by a *Storm*, did acquire a *Magnetick Virtue* from the *Earth*, ſo as that the parts of it did attract *Iron Nails*, and turn themſelves towards the *Poles* of the *World*. So likewiſe it is obſerved, that when a *Rod of Iron* has toucht the *Earth*, the lower part of the *Rod* draws the point of the *Needle* of a Compaſs that points to the *South*, to it ſelf.

This happens becauſe of the great affinity there is between the *Loadſtone* and *Iron*: for they are ſo much alike, that the *Loadſtone* may be called *Raw* and *Undigeſted Iron*; and *Iron* the Riper and more Pure part of the *Loadſtone*. For *Iron* is melted out of the *Loadſtone*, as out of its proper *Vein*. Hence it is, that in *England*, *Germany*, *Italy*, and other places where *Iron* is found, the *Loadſtone* is found alſo, as proceeding both of them from the ſame *Matrix*. But as for the manner how

Iron

Iron is made partaker of the *Virtue* of the *Magnet*, and by touching it, doth acquire the ſame *Inclination*: This we ſhall underſtand if we ſuppoſe that *Iron* is endued with fit *pores* to receive the *ſtriate matter*, and that it wants nothing towards the obtaining of this *Magnetick Virtue*; but only that ſome little *branchy particles* ſticking out in the *pores* of it, which do make them ſomewhat rough and uneven, muſt be bended one way for the eaſie paſſage thereof. Now upon the application of a *Loadſtone* to *Iron*, the *ſtriate matter* which continually takes a round from one Pole of the *Earth* to another, with vehement force and in great quantity, ruſhing like a *Torrent* into the *Pores* of the *Iron*, doth bend theſe prominent extremities of the *branchy particles* all one way; and therefore effects whatſoever is neceſſary to the making of it fit partaker of this *Magnetical Virtue*.

X. *Why Steel is more proper and fit to admit this Magnetick Virtue than Iron.*

Hence it is that *Steel* is more proper to receive this *Magnetick Force* than *Iron*, becauſe it hath more, and more accurately framed *Pores* for the reception of theſe *ſtriate particles*. And doth alſo preſerve the ſaid *Virtue* longer, becauſe the prominences of the extremities of theſe *branchy particles* that are in the *Pores* of the *Earth*, are leſs flexible, and therefore cannot ſo eaſily be bent the contrary way.

XI. *How Steel Sciſſars may be made partakers of a Magnetick Virtue.*

The Famous *Mathematician* Mr. BUOT hath found by experience, that *Steel Sciſſars* or *Penknives* having been heated in a *Forge* till they be of a *Red Colour*, and then ſuddainly extinguiſht in *cold water*, and afterwards neal'd in the *fire* again, till they be of a *Blue* or *Purple Colour*, and then whetted and made bright on a Whetſtone, if preſently after they be made to cut, or pierce through *Plates* of *Iron* or *Steel*, by this means a *Magnetick Virtue* will be communicated to them, ſo as to attract *Iron Nails*. Of which no other reaſon can be aſſigned, but this, becauſe the *Pores* are ſo diſpoſed in *Steel* prepared after this manner, that the *Heavenly matter* can with more eaſe have Egreſs and Regreſs through them: So as that no out-flowing *particles* from the *Magnet* do remain, but doth only afford a free paſſage to the *External matter*.

XII. *Why an Armed Loadſtone doth attract ſtronger than one that is Unarmed.*

The *Armed Loadſtone* A, doth bear up more *Iron* B and C, than another that is not: For GA. LILÆUS hath obſerved, that a piece of *Loadſtone* weighing 6 *ounces*, will ſcarcely bear 2 *ounces* unarmed; whereas the ſame *Loadſtone* armed will bear up 160 *ounces*; ſo as that it attracts 8 times more than when it is unarmed, and a weight 25 times greater than its own weight.

Figure 22.

The cauſe of this encreaſe of the attractive *Virtue* is, becauſe the *Iron* D E, wherewith the *Magnet* A is armed, is endued with *Magnetical Parts*, that are purged from *Terreſtrial Filth*, and *Heterogeneous Impurities*; for which reaſon its *Pores* do moſt fitly correſpond and agree with the *Pores* of the *Iron* that hangs at it B and C, and by this means the *ſtriate particles* that paſs through theſe *Pores* from the one *Iron* into the other, do drive away all the *intermediate* air, and makes their ſurfaces to touch one another immediately; by which means they cannot, without great difficulty, be ſeparated; and therefore the *weight* B, or C, doth ſtick more ſtrongly to the *Iron* D E. For nothing can be more proper to join 2 *Bodies* together, than immediate contact.

XIII. *A Loadſtone throughly heated loſeth its force to draw Iron.*

A *Loadſtone*, being throughly heated, loſeth its force of drawing of *Iron*, and doth no longer turn towards the *Poles* of the *World*. For if you heap live Coals about a *Loadſtone*, you will ſee a Blue *Sulphurous Flame* to break forth from it; upon the diſſipation of which you will judge it to have loſt its attractive *Virtue*.

The Cauſe of this *Loſs* of the *Magnetical Virtue* is, for that the *Fire* entring into the *Pores* of the *Magnet*, many of its thin and *ſlippery parts* are driven away; upon the removal whereof, a new texture of *Parts* is produced in the *Magnet*. As we ſee that a *Stick* being put into the *Fire*, becomes crooked by degrees; becauſe the force of *Heat* brings ſome of its parts cloſer together, and at the ſame time ſeparates others of them. The *Fire* therefore having thus changed and confounded the former ſituation of the *particles* of the *Loadſtone*, the *ſtriate matter* which was uſed to paſs through them, finding the *Pores* much wider than they were before, doth exert but a very ſmall force, or rather none at all upon them.

XIV. *A Magnet that hath been heated, may recover its loſt Virtue again.*

Tho' there be many great *Philoſophers*, who deny that a heated *Magnet* can ever recover its loſt *Virtue* again; yet the contrary hath been found by experience. Some indeed have obſerved, that a *Magnet* that hath been made red hot, is by this means robb'd of the greateſt part of its *Virtue*, and changeth its *Poles* in caſe it be placed to cool in an inverted ſituation towards the *North*. Or if when it is a *cooling*, the ſituation of it be frequently changed from one poſition to another that is oppoſit, it will wholly change its *Poles*; ſo as that that which was before the *North* Pole, will become the *South*, notwithſtanding that the *Loadſtone* be then placed perpendicularly upon the *Horizon*.

XV. *Glaſs drops when put to the Fire, loſe their Elaſtick Virtue.*

Thus thoſe *Glaſs-Drops*, which upon the breaking off of their *Points* become ſhattered into the ſmalleſt *Duſt*, being by degrees put to the *fire*, do loſe their *Elaſtick virtue*.

The Reaſon is, becauſe the *Parts* which before were ſtretched, are made wider by the admiſſion of *Heat*, and by degrees ſit looſer from one another; and thus the *Texture* of the *parts* being changed, they are now no longer like *Sticks*, with *Wreaths* twiſted hard about them, and therefore do not ſo ſtrongly reſiſt the force of the *Hammer*, and become wholly deprived of their *Elaſtick virtue*.

XVI. *A Loadſtone upon the changing of its Poles, doth loſe its Virtue alſo.*

But if a Piece of *Iron* be applied to the *Pole* of a *Magnet* from the Right to the Left, it preſently loſeth the *virtue* it had before acquired; becauſe the parts of the *Magnet* are changed, by this contrary paſſage of the *ſubtil matter* through them, and the *pores* differently ranged and formed from what they were before. And on the contrary, it hath been frequently found by Experience, that the *Iron-bars* of *Windows* looking towards the *North* or *South*, do retain a perpetual *Magnetick virtue*: Becauſe the *ſtriate Matter* that proceeds from the ſaid *Poles*, by proceſs of time, do hollow *pores* for themſelves through the ſaid *Iron-bars*.

XVII. *How a Magnet may be ſome time hindred from drawing the Needle to it.*

A *Plate* of *Iron*, which we have ſaid before, being joyned to the *Pole* of the *Loadſtone*, doth increaſe its force to bear *Iron*, doth hinder the *virtue* it hath of turning *Iron* towards it. For the *Iron-Plate* D C D, doth hinder the *Loadſtone* A B,

Figure 45. in the Institution.

A B, to whose *Pole* it is joyned, from drawing the *Needle* E F towards it.

The Reason is, because the *striate Particles* that proceed from the *Loadstone*, do rather pass through *Iron*, than any other *Body*; and therefore the said *particles* are diverted by the *Iron-Plate*, from passing through the *Air* to E F. And certainly, besides the *Iron* or *Magnet*, no other *Body* can be substituted in place of the *Iron-plate* C D, by which the *Loadstone* A B is hindred from exerting its force upon the *Needle* E F; as hath been said in the *Institution of Philosophy*.

XVIII. *Whether there be any thing of Truth in the story of* Mahomets *Tomb.*

There is a Common Story goes of MAHOMET's *Tomb*, that it is pois'd in the midst of the *Air*, between 2 *Loadstones*, without touching either the top or the bottom of the *Temple* at *Mecha*.

I take this to be a meer *Fable:* For it is beyond the power or wit of *Man*, to get 2 or more *Magnets* that are altogether of the very same force and virtue; and if these could be got, yet would it still be as impracticable, or rather impossible to place them so, as that the *Iron* placed between them, should not be drawn in one part of it more than in the other: Seeing that a very small and inconsiderable difference in the *Loadstone*, *Iron*, or in the place it self, would be sufficient to overthrow that Equality. Neither are we to ascribe any greater Authority to the *Stories* that some *Authors* tell us of the *Horse* of *Bellerophon*, and of the *Statue* that was in the *Temple* of *Serapis*. These being nothing else but pure invented *Stories*, which have gained Authority by the *Credulity* of the *Vulgar*.

The Sixth Part OF THE HISTORY OF NATURE. OF METEORS.

CHAP. I.

Of Vapours and Exhalations.

I. *Why Vapours are more copious in* Winter, *than in* Summer,

MORE *Vapours* do seem to arise from the *Earth* in the *Winter*, than in the *Summer*, when the *Sun* with more direct *Beams* beats against the *Earth*, and more strongly agitates the fluid *particles* of *Pools* and *Rivers*. Hence it is that we have then greater store of *Rain*, and that the *Air* is more darkned with *Mists* and *Clouds*.

This is the *sentiment* of the Common *People*, who judge of the *OEconomy* of *Nature*, only by the outward *Senses*, and without examining, embrace whatsoever they offer first. But Reason will perswade us to be of another opinion: For the *Sun*, who, by his presence, raiseth *Vapours* and *Exhalations* into the *Air*, doth in *Summer* display his *heat* more upon *Pools*, and *moist* and *boggy places*, than in *Winter*; when his *Beams* do only obliquely or slantingly strike against the *Earth*; and consequently at that time produce a weaker agitation in the *waters*. Moreover, we find that the *waters* in *Summer* do signally decrease. Wherefore the true reason why *Vapours* are in greater abundance in *Winter* is, because the *Air* being then *Cold* by reason of the *Suns* absence, the *Vapours* cannot mount up to any considerable height in the *Air*, but are presently condensed, and so becoming heavy, fall down again to the *Earth*.

II. *Why more Exhalations do arise from one part of the Earth, than from another.*

It is observed that *Exhalations* proceed more copiously from some parts of the *Earth* than from others; not only from those which are covered with thick and close *Woods*, but even in those which are equally enlightned by the *Sun*.

The Reason of this may be, some *subterraneous Fires*, which by putting the moisture that is shut up in the *Earth* into motion, do, through various *passages*, transmit and disperse it. For it is not to be questioned, but that there are Fires hidden in many parts of the *Earth*; which meeting with *matter* fit to be turn'd into *Steams* or *Exhalations*, do drive the same upwards. As we find that *Gardens* that are kept in good order, and *Ploughed Ground* do send forth more *effluvia* than other places, especially if they be much exposed to the *heat* of the *Sun*.

III. *Vapours and Exhalations stop in the Air at a certain distance from the Earth.*

Vapours and *Exhalations* do not mount up to any considerable height in the *Air*, but there stop at different distances from the *Earth*.

The

The *Lower Region* of the *Air* is hotter than the Middle, and the Middle hotter than the Higheſt, not only becauſe they are nearer the *ſubterraneous Fires*, and thoſe *firmentations* which are excited in the more outward parts of the *Earth*; but alſo by reaſon of the *Reflexion* of the *Suns Beams*, which is the chief cauſe why the *heat* of this *Star* is greater in thoſe *Regions*. Now this ſuppoſed, it is evident that the *Vapours*, being lighter, may aſcend to the higheſt Region of the *Air*, whilſt the *Exhalations* can ſcarcely get up to the middle, where moſt of the *Meteors* are forged and produced; and this by reaſon of the great variety of *degrees* of *Cold* and *Heat*, which by turns do there bear ſway.

IV. *Why Water, when turned into a Vapour, doth take up more place than it did before.*

Water, when it is turned into *Vapour*, takes up much more room than before; foraſmuch as the parts whereof the *Vapour* conſiſts, becauſe of their ſwift agitation, do ſpread themſelves every way, and are ſwiftly whirl'd about, and thereby extend more in length; ſo that by this means every one of them are of force enough to drive away any neighbouring parts that would make an irruption into the *Rings*, which by their *circulation* they deſcribe. Much in the ſame manner, as when the Stick L M, through which the piece of *Cord* N P, is put, being violently turn'd round, the *Cord*, by this means, is extended at its full length, and fills up the whole ſpace of the *Circle* N O P Q, ſo that no other *Body* can enter the ſaid ſpace, but that the *Cord*, in this its motion, would drive it away.

Figure 23.

V. *Rarefied Air doth not turn to Fire, as* Ariſtotle *held.*

This ſhews ARISTOTLES miſtake, who was of opinion, that the *Air* may be ſo dilated, as to change its nature, and to take upon it the form of *Fire*: For it is found by experience, that if the *Bladder* of a *Pike* be prickt with a *Pin*, and all the *Air* let out, and then it be ſo cloſely tied up again, that no *Air* can enter into it; if afterwards the ſaid *Bladder* be put into a *Glaſs Pipe*, having a broad Bottom, and a wide Mouth, being tied cloſe about with a *Hogs Bladder*, and *Quick-ſilver* put into it, it will diſplay it ſelf, and ſwell into the ſame dimenſions, as it was when firſt it came out of the *Fiſh*, tho' the *Air* in the *Bladder* be above an 100 fold rarefied above what it was before, by the agitation of the *ſubtil matter* contained in it.

VI. *Why the ſteam of a Mans Breath is condenſed into water againſt Glaſs Windows.*

The *Steam* proceeding out of a *Mans Mouth*, in *cold weather*, is condenſed on the Panes of a *Glaſs Window*, into drops of *Water* or *Ice*.

The Reaſon is, becauſe the *Vapours* by the heat of the *Stomach*, are carried to the *Windows*, and being not able, becauſe of their thickneſs, to paſs through them, become there condenſed into *Water*; and if the Weather be very cold and froſty, they turn to *Ice*, and repreſent ſeveral *figures* on the *Glaſs*.

VII. *Why ſome Bodies ſend forth healthful, and others hurtful Exhalations.*

The *Steams* that proceed from *Bodies*, are diſtinguiſh'd by their *ſmell*; for ſome are good and *healthful*, others evil and *hurtful*. In places where abundance of *Roſes* grow, the whole neighbouring Air is filled with a *ſweet Roſie Odour*: Whereas on the contrary, in *places* where *Dug* or *Carrion* is caſt forth, the *Air* is annoyed with abominable and noxious *Vapours*, and ſtinking *Smells*.

The Reaſon is, becauſe theſe *Effluvia* which wander through the *Air*, are nothing elſe but lively and active *particles* of *Earthly Bodies*; which being agitated by the *heat* of the *Sun*, are carried upwards, in the very ſame manner as we ſee that a *wet Cloath*, hung before the *Fire*, doth ſend forth *vapourous Steams*. Wherefore all manner of *Exhalations*, are either *healthy* or *hurtful*, according as the *Bodies* from whence they proceed, are either *ſound*, or tending to *putrefaction*. Thus we find that the *Vapours* which ariſe out of the *Earth* are *dry*, becauſe they conſiſt of dry *terreſtrial particles*: Whereas thoſe that are *ſublimed* from the *Sea*, are *moiſt* and *cold*; becauſe they conſiſt of *fluid* and *ſlippery Aqueous particles*, which running together, conſtitute a liquid and cold *Body*.

VIII. *Why ſo many die in* London *of the Conſumption.*

Accordingly we find that obſervation to be very true which Sir KENELM DIGBY makes of *London*, in his *Treatiſe* of the *Sympathetical Powder*, *viz.* that in the *Winter* eſpecially, the *Air* is filled with *Soot* and *volatil Salt*, from the *Smiths Coals* that are generally there burnt, which flying in the *Air*, enter the cloſeſt ſhut Rooms, Trunks and Cheſts; ſullies and ſpoils the *Furniture* of *Beds* and *Hangings*. And it is not without reaſon, that *Phyſitians* attribute to this cauſe, that ſo many are troubled with, and die of *Conſumptions* of the *Lungs*; becauſe the *Air* abounding with ſuch *particles*, is very apt to inflame and exulcerate the *Lungs*.

IX. *Why ſome ſteams are noxious to the Body.*

From what hath been ſaid, we may eaſily ſee the reaſon why *Steams* are the cauſe of the infection of the *Air*, and of the corruption of the *Bodies* of *Animals*. For as the *particles* of *Rennet* being diſperſt through the *ſubſtance* of *Milk*, do change the ſituation of its parts, and make that which before was *liquid*, a *fixed* and *hard Body*: So likewiſe the *particles* of *peſtilential Steams*, penetrating the *pores* of the *Air*, do pervert and overthrow the *Texture* of its *parts*, and cauſe malignant *Diſtempers*.

X. *Exhalations are the cauſe of innumerable diſtempers.*

And accordingly it is moſt certain, that innumerable *Diſeaſes* are cauſed from *poiſonous Steams*. And foraſmuch as theſe *Fumes* do commonly proceed from *Mineral Juices*, therefore the deſtruction that is cauſed by them is ſo much the greater, as abounding with ſharp and corroſive *particles*, which are the fruitful *ſeeds* of many malignant *Diſtempers*, and are very noxious to the *vital Spirits*. Thus we find that in ſeveral places ſuch *poiſonous Exhalations* break forth out of the ground; as at *Puteoli*, where there is a *Pool* or *Lake* which ſends forth ſulphureous *Steams* that are pernicious to the very *Birds* that flie over it. In like manner there are many places in *Campania*, where abundance of *ſulphureous* and *bituminous Exhalations* proceed from ſome *ſubterraneaan Cavities*, ſome whereof are healthful, and others hurtful.

XI. *The Evening Air is found to be hurtful to many.*

To theſe *Exhalations* and *Steams*, now mentioned, may be added that *ſubtil Steam* or *Breez*, which being ſublimed from the *Earth* in the day time, and falling down again after Sun ſet, is call'd the cool evening *Air*, and found to be hurtful to many, eſpecially to thoſe who are of a leſs compact frame of *Body*, and whoſe *pores* are more *open*. This *Steam* is alſo wont to be more hurtful about the time of the *Æquinoxes*, eſpecially in places that abound with *Mineral Exhalations*. For a moderate *heat* raiſeth a vaſt number of *Vapours*, eſpecially in moiſt and moriſh places; which ſteams, becauſe they abound with ſharp and *corroſive*

roſive particles, enter through the *pores* into the *Head*, and cauſe *Tooth-ach*, and many defluxions; as alſo by their ſharpneſs, opening the *Capillary Veins*, they occaſion great *bleeding* and *watchings*, and are in a particular manner noxious to the *inſtruments* of *Reſpiration*.

XII. *Exhalations are not ſo eaſily carried upwards as Vapours.*

Vapours are more eaſily carried upwards than *Exhalations*, as may be ſeen in the *diſtillation* of common *Salt*, *Nitre* and *Vitriol*, whoſe *Exhalations* do not riſe without a great force of *Fire*.

The Reaſon is, becauſe the *water* which furniſheth the *matter* of *Vapours*, conſiſts of long ſmooth and ſlippery parts, *figured* ſomewhat like *Eels*; which tho' they be entangled together, yet are never ſo cloſely joined, but that they may be eaſily ſeparated from one another. Whereas the *Earth*, whence *Exhalations* do ariſe, conſiſts of more irregular parts, which, like *Sprigs*, grow cloſe together in *Hedges*, are eaſily twiſted together, and cannot without difficulty be ſeparated again. Wherefore *Vapours* that conſiſt of the thin and ſlippery parts of the *water* do more readily mount up than *Exhalations*; which becauſe of the cloſer texture of *their parts* are kept down, and cannot aſcend, except they be born up by other Bodies.

XIII. *Why our Breath feels more hot when breathed with an open Mouth, than when our Mouth is drawn together.*

A hotter *Steam* or Breath proceeds from an open *Mouth*, than from one half ſhut.

The Reaſon is, becauſe heat conſiſts in the agitation of the little *particles* of the terreſtrial Bodies; wherefore when we blow ſtrongly againſt our Fingers, cloſe joined together, we find that our Breath feels *cold* in the outward *ſurface* of our *Hand*; becauſe being carried there moſt ſwiftly, and with equal force, doth not produce any conſiderable agitation; whereas on the contrary we perceive it to be conſiderably *hot* betwixt our *Fingers*, becauſe being more ſlowly and unevenly moved betwixt them, it puts their ſmall parts into a greater *motion*. And it is for the ſame reaſon that we feel that breath *hot*, which is breathed from our *open Mouths*, whereas that which is blown from them when almoſt ſhut, ſeems *cold* to us. As we find that commonly violent *Winds* are *cold*, and the gentle are commonly the *hotteſt*.

XIV *Why we can ſee our Breath in the* Winter, *and not in the* Summer.

The Breath of *Animals* is viſible in *Winter*, as alſo the *Steams* that proceed from them in *ſweating*; but not in the *Summer*.

The Reaſon is, becauſe the *particles* of the *Vapours*, which in *Summer* are carried through the *Air*, do more comply with the *motions* of the ſubtil *matter*, and give way to all its impulſes. But in the *Winter*, when the ſubtil *matter* is more weakly agitated, the *breath* is condenſed by the *coldneſs* of the *Air*, and is frequently turned into *water*; and in extream *cold* and *froſty weather* doth turn to *Iſicles* on the *Hair* of Mens *Heads* and *Beards*. Whereas in the *Summer* they are not perceived at all, becauſe of the heat of the *Air*, which diſperſeth them far and near.

XV. *Steams proceed from all Bodies.*

Wherefore it cannot be queſtioned, but that the moſt *ſolid* Bodies do ſend forth ſome *Steams* or *Effluvia* from them, which compoſe a kind of *Atmoſphere* about them. As is evident, not only in *Amber*, *Camphire*, *Spaniſh-wax*, and the like, which diffuſe their *Odour* through the *Ambient Air*; but alſo in *Wooden Veſſels*, which being exactly weighed, will be found to have loſt ſomething of their *weight*: And in *Eggs*, whoſe ſubſtance evaporates, even in the coldeſt ſeaſon; yea and in *Ice* it ſelf, which being expoſed to the *Air* in the Night, doth decreaſe in *heavineſs*, and is conſiderably diminiſh'd as to its *ſubſtance*. And if in ſome Bodies, ſuch an *efflux* of *particles* be not perceived, the reaſon hereof probably may be, becauſe we have no *Scales* exact to diſcover the ſame, ſeeing that the *Scales* and *Weights* themſelves are ſubject to this decreaſe by a continual *efflux* of *particles*, and are not always the ſame weight.

XVI. *But moſt of all from Human Bodies.*

But theſe *Effluvia* are no where more ſenſibly perceived, than in the inſenſible Tranſpiration of *Human* Bodies. For SANCTORIUS affirms, that he by an exact weighing of himſelf, found that more than one half of our *Food* and *Drink*, paſſeth by inſenſible *Tranſpiration*; and that we evacuate more of our *Aliments* through the *pores* of our *Skin*, in one day, than we do by Siege in 15 days; which is an inconteſtable proof of the *Steams* that continually proceed from our Bodies.

CHAP. II.

Of Winds.

I. *Why Winds are more frequent in the Spring and Autumn, than at other Seaſons of the Year.*

WINDS are more frequent in the *Spring* and *Autumn*, and do blow with greater violence, than in *Summer* or *Winter*.

The Reaſon why it thus happens in the *Spring* is, partly becauſe of the melting of *Snow*, eſpecially in *Mountainous Places*; and partly becauſe the *pores* of the *Earth* are then opened, and ſend forth more *Steams* or *Vapours*; and partly alſo becauſe the *Air* and *Vapours* are then more rarefied than in *Winter*. And in *Autumn*, the reaſon is to be aſcribed to the frequency of *Rains* that then fall, as well as to the greater quantity of *Exhalations*; becauſe the *Suns moderate heat*, which then takes place, doth raiſe *Vapours* and *Exhalations*, but groſs ones, and not ſufficiently rarefied. Whereas in the heat of *Summer*, there are for the moſt part no *winds*, for the ſame reaſon that *Rains* are very ſcarce then; and becauſe the *Sun* doth too much extenuate the *Exhalations*, and ſo prevents them from uniting in that quantity, which is requiſit for the *Generation* of *Winds*. And in the midſt of *Winter*, winds are leſs frequent, not only becauſe leſs quantity of *Vapours* is at that time raiſed from the *Earth*, but alſo becauſe thoſe which are ſo raiſed, are either condenſed into *Snow*, or at leaſt by reaſon of the *cold*, are not ſo rarefied and diſperſed as to be able to produce a *Wind*.

II. *Why an* East *Wind commonly blows in the Morning, and a* Weſt *wind in the Evening.*

About the *Suns Riſing*, an *Eaſt* wind is commonly perceived, and about *Sun Set* a *Weſtern*: which difference they are moſt ſenſible of, who *ſail* in the *Ocean*, at a great diſtance from *Land*.

This proceeds from the preſence of the *Sun*, which puts the *particles* of the *Earth* in motion, and lifts up *Vapours* into the *Air*: For ſeeing that a great part of the *Earth* is always illuminated by the *Sun*, it muſt of neceſſity raiſe many *Vapours* from thence, which upon its departure fall down again, and betake themſelves to the *Eaſt* and *Weſtern* parts of the *World*, to ſucceed in the room of thoſe *Vapours* which the coldneſs of the *Night* hath condenſed in thoſe parts: And therefore they who

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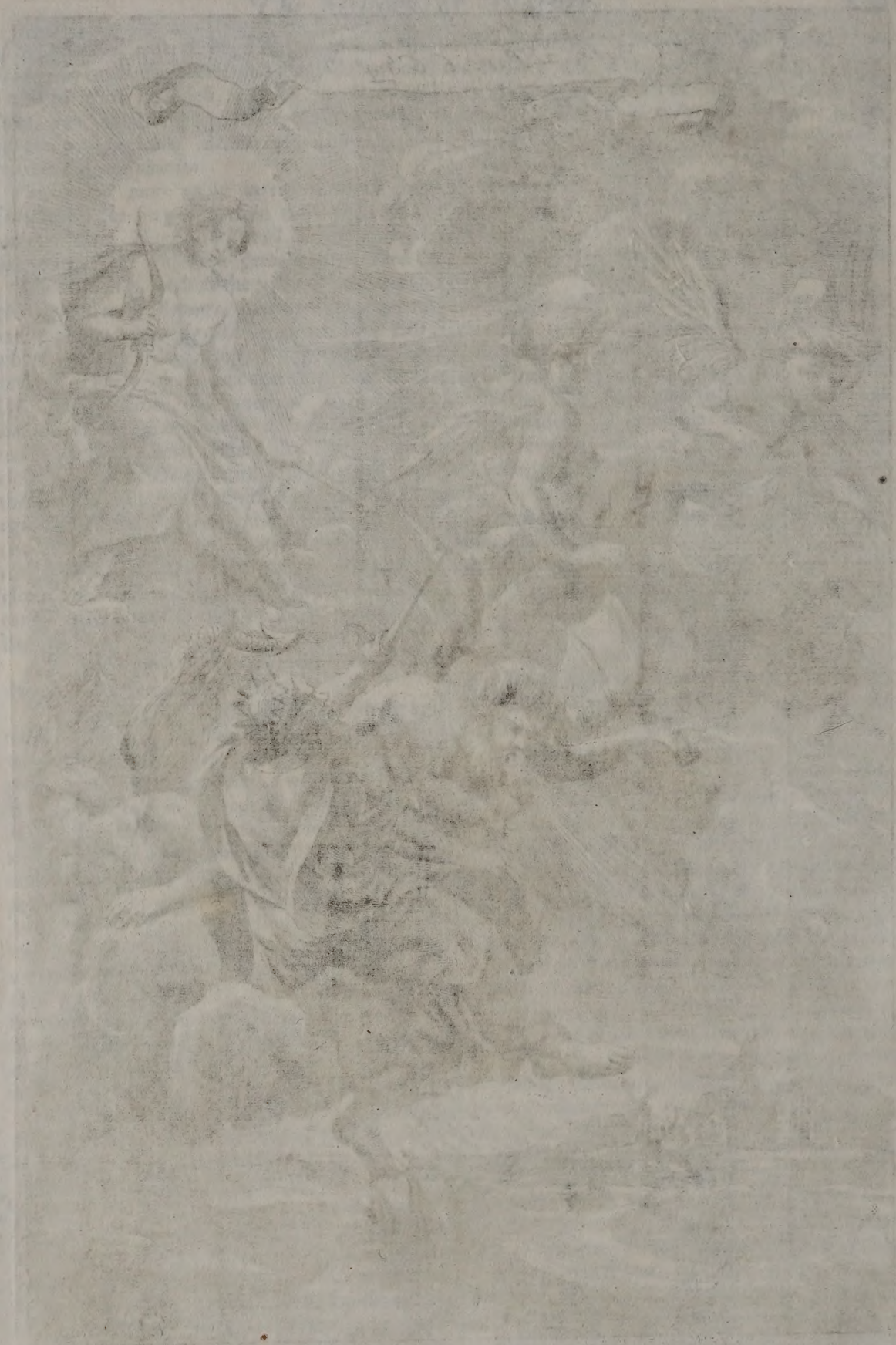

who live in the *Eaſtern* parts, perceive an *Eaſt-wind*; and thoſe in the *Weſt*, a *Weſt-wind*. This will appear more clearly by conſidering the *Figure*, where A B C D repreſents the Compaſs of the *Earth*, S, the *Sun* oppoſite to it, who darting his *Beams* againſt the *Hemiſphere* A B C, and making *Noon* at B, and *Midnight* at D, doth at the ſame time Set to the *People* that live at A, and Riſeth to them who live at C. For the *Vapours* about B, which are rarefied by the Heat of the *Day*, and do by oppoſite ways tend towards D, *viz.* by A and by C, to take up the place of thoſe *Vapours*, which the Cold of the *Night* hath condenſed, do produce a *Weſtern-wind* at A, where the *Sun* ſets; and an *Eaſtern-wind* at C, where the *Sun* riſeth. Figure 24.

III. *Whence the difference of Winds doth proceed.*

Whence it follows, that the *Fermentations* that happen between the *Tropicks*, produce *Winds* that are either contrary to, or agree with the *Eaſt-wind*, according as that part of the *Earth*, where they are generated, is differently ſituated with regard to the *Sun:* Whence it comes to paſs, that the *Eaſt-wind*, which reigns conſtantly betwixt the *Tropicks*, is ſometimes ſtronger, and at other times weaker, as Experience ſheweth.

I have ſaid before, that this *diverſity* of *Winds* is moſt of all perceptible to them that *Sail* in the vaſt *Ocean*; becauſe at *Land* there be many things that hinder us, that we cannot ſo well obſerve this order of the *Winds*, *viz.* the height of *Mountains*, and the great variety of *Climats*.

IV. *Why Eaſt-winds are dryer, than VVeſt-winds.*

Eaſt-winds for the moſt part are dryer, and produce fair and clear *weather*; whereas thoſe from the *Weſt* are commonly *moiſt*, and bring *Vapours*.

The Reaſon hereof muſt be deduced from the *motion* of the *Air*, which is carried about the *Earth* from *Eaſt* to *Weſt:* For ſeeing that the *Winds* that are generated at C, follow the *motion* of the *Air*, they conſequently drive before them all the *Vapours* they meet with, and diſſipate them, and ſo hinder them from being condenſed and turned into *Rain*. But thoſe which are produc'd in the *Weſt* A, ſeeing that they ſtrive againſt the *motion* of the *Air*, and take a different courſe from it, they ſtop the *motion* of the *Vapours* they meet with, and drive them together into *Clouds*. And for the ſame Reaſon, *winds* that proceed from the *Eaſt* C, are generally ſtronger, and blow with greater force, than thoſe that blow from the *Weſt* A; becauſe thoſe which are forged at C, follow the courſe of the whole Maſs of *Air*. Or elſe, becauſe by reaſon of the longer abſence of the *Sun*, the *Vapours* are more cloſely condenſed in that part of the *Earth* which is between C and D, than in that which is betwixt D and A. Now it is certain, that the *Condenſation* of *Vapours*, contributes to the force and violence of *winds*; which are by ſo much the more vehement, the more heavy the *parts* are whereof they conſiſt.

V. *VVhy about the Sea-Coaſts, the VVind at Night blows from the Land, and in the Day time from the Sea.*

On the *Sea-Coaſt*, the *winds* are found to blow from the *Sea* in the *Day-time*, and from the *Land* in the *Night*.

This *ſhifting* of the *Wind* depends on the *Illumination* of the *Sun*, whereby it differently raiſeth up *Vapours* from the *Sea* and *Earth*. For whilſt the *Sun* ſhines, he commonly raiſeth more *Vapours* from the *Sea*, than the *Earth*; becauſe the *Earth* is dry in many places, and doth not afford ſuch plentiful *matter* for *Vapours*, as the *Water:* And, on the contrary, when the *Sun* withdraws, more *Vapours* riſe from the *Earth*, than from the *Sea*; becauſe the *Earth* being a compact *Body*, and abounding with *moiſture*, doth longer retain the *Heat* impreſt upon it, than the *Sea*. And therefore thoſe ſtrong *winds*, which blow from Midland places upon the *Sea*, are ſtrongeſt next to the *Shoar*; but grow weaker, the further they proceed on the *Sea*. From whence COLUMBUS, the firſt Diſcoverer of the *Weſt-Indies*, gather'd, that there were other *Countries* beyond the *Atlantick Ocean*, and thoſe not far off neither; becauſe he found ſuch ſtrong and violent *winds* to blow from the *Sea* towards *Europe*, which he concluded to be too vehement to proceed from the *Sea*.

VI. *VVhat the Cauſe is of the winds called* Eteſiæ, *and of other Conſtant winds.*

There be ſome *Winds* that return at certain times, and always obſerve the ſame courſe; as the *Eteſiæ*, which every Year blow for 40 *Days* together, beginning 2 *days* after the Riſing of the *Dog-Star*. *Weſt-winds*, which blow from the *Vernal Æquinox*, to the *Autumnal*, in the *Mediterranean Sea:* And *South-winds*, which are produc'd under the *Torrid Zone*, and have their *daily*, *monthly*, and 6 *monthly* Returns, or Reciprocations.

The *Sun* is the only Cauſe of all theſe conſtant or ſtationary *winds*, who, according to his various approaches to, or receſſes from the ſeveral Parts of the *World*, effects this great *diverſity* herein. For as to the *Eteſiæ*, which are obſerved after the *Summer Solſtice*, it is probable that they proceed from *Vapours*, ſublimed by the virtue of the *Sun* from the *Earth* and *Water*, that are in the Northern parts, after that he hath continued a great while about the *Tropick* of *Cancer*. For it is certain, that he continues longer at the *Tropicks*, than in the Space that is between them. And we are to conſider, that in the Months of *March*, *April* and *May*, the greateſt part of the *Clouds* and *Snow* which were about our *Pole*, are reſolved into *vapours* and *winds*; and that theſe *winds*, from the beginning of the *Spring* (at which time they are at the ſtrongeſt) towards the *Summer Solſtice* do grow weaker, as the Matter of them decreaſeth. And that in *June*, the *Earth* and *VVater* is not yet ſufficiently heated there, to furniſh Matter for a new *wind:* But when the *Sun* continues about the *Tropick* of *Cancer*, they become more ſtrongly heated, and by this means produce the *Etheſiæ*, when the *Noon* of that long *Day*, which continues there 6 Months, begins a little to decline.

VII. *The winds called* Ornithiæ, *are near akin to thoſe* Eteſiæ.

Theſe *Eteſiæ* have a great affinity with the *winds* called *Ornithiæ*, which blow from *South* to *North*, and bring back the *Birds* from the beyond *Sea* hotter *Countries* into *Europe*, and are therefore called *Ornithiæ*, or *Bird-blowing-winds*. But yet ſometimes theſe *winds* ſtop in the midſt of their courſe; and therefore it is obſerved, that *Swallows* are very rare in *France*, when *North winds* have blown much towards *Africa* at the beginning of the *Spring*.

VIII. *In the* Indian *Seas, and those of* Arabia, *the Winds blow constantly.*

Experience teacheth us, that in the *Indian* and *Arabian Seas*, which are so situated with respect to the Continent of *Asia*, when the *Sun* heats the same from *April* to *October*, the *Air* which is condensed on the South-side of the *Æquator*, doth transport it self with so much impetuosity, towards the North-side of it, that it makes the *North-east-wind* not to be perceived, which blows at the same Latitude in the *Atlantick Ocean*. And, on the other hand, when the *Sun* doth heat the *Seas* which are on the South-side, from *October* to *April*, then the *Air* which becomes condensed towards the North by the Cold of the *VVinter*, that remains there, doth take its course with that violence towards the South, that it doth entirely over-power the *South-east-wind*. Which is the Reason, why in these *Seas* there is only perceived a *Periodical-wind*, which blows one half of the Year on one side of the *Æquator*, and the other on the other side.

IX. *The West-winds blow at a certain time of the year in the Mediterranean.*

In like manner *West-winds* usually blow in the *Mediterranean-Sea*, from the time of the *Vernal Æquinox* to the *Autumnal*; because a great quantity of *Vapours* is, during the Heat of *Summer*, drawn up from the *Atlantick-Ocean*; and some Hours after *Sun-Rising*, which answer to a set space of Time after *Midnight*, are driven towards the *East*, and continue their activity till *Sun-setting*. The *winds* betwixt the *Tropicks* are certain and stationary; because the *Sun* there darting direct and perpendicular *Rays* towards the *Earth*, doth by this means raise many *Vapours*, which being put into motion by the *Action* of the *Light*, do diffuse themselves and produce a *wind*. And in like manner it may be said of other *winds*, which rise at certain times; as of the *Southwest-wind by West*, which blows from the *Eastern-shoar* of *Africa*, towards *Morambique*, from the beginning of *August* to the 15*th* of *September*; that they are caused by the *Sun*, who raiseth plenty of *Vapours* out of the *Indian-Sea*, from *April* to *August*, which take their course towards *Africa*, and having got more room, do there dilate themselves.

X. *How Artificial-winds may be made.*

Winds may be raised by Art, as appears by that *Instrument* called the *Chymists Bellows*; which consists of a *hollow Copper-Globe*, so contrived as that it may be filled with *water*, and afterwards shut up close; having a *Pipe* with a very narrow Mouth jetting out from one part of it, which *Instrument* thus fill'd with *water*, is plac'd near a Fire, the Pipe being turn'd towards that *Fire* which is to be blown up: Whereupon, as soon as this *Globe* grows hot, the *water* becomes rarefied, and bursts forth through the narrow Mouth of the *Pipe*, in the manner of a strong blast or *wind*, and so serves for a *Bellows* till all the *water* be consumed.

In this case the *particles* of the *water* being agitated by the *fire*, dash together, and with strong Endeavours strive to get away from one another; and because they cannot dilate themselves, nor depart from each other, but only so far as some of them get out through the *Pipe*, all this force wherewith so many of them clash together, being united, doth drive the parts that are next to the *Pipe*, with great violence into the open *Air*, and by this means a blast or *wind* is caused. And forasmuch as by the *fires* continual Action, other parts of the *water* are still rarefied, and being whirl'd about, do withdraw from one another, whilst others of them endeavour to get out of the *Pipe*; by this means the *wind* ceaseth not, until all the *water* that is in the *Globe* be evaporated, or that the *fire* be removed from it.

XI. *Why winds are most vehement in the Winter.*

Winds do rage most in the *Winter*, and cause more *stormy weather*, than at other times; which *Sea-men* are very well aware of.

The Reason is, because the *Sun* at that time draws towards the *Southern Tropick*, and therefore occasions a less Resistance against the *North-winds*. To which may be added, That in the *VVinter*, the *South-west*, or *South west and by VVest-wind* comes down with more force from the Mountain *Atlas*, or the *Southeast-wind* from the Mountains of *Syria* and *Arabia*. But the *VVinds* are never more *stormy* than in *March* and *September*, because the *Heaven* then is subject to many mutations, and frequent vicissitudes of *heat* and *cold*, *moisture* and *drought*.

XII. *Why the South-wind is unhealthful.*

The *South-wind* is, for the most part, *unhealthful*, and causeth Colds or Stuffings of the *Head*. Hence it is, that when the *South-wind* blows, People grow more *peevish*, and more unfit for their Studies.

The Reason is, because the *South-wind* being *moist*, carries many *Vapours* along with it, which enter into the open *pores* of the *Body*, and are carried to the Inward parts of it. Whence proceed Colds and Stuffings of the *Head*, and Dulness of the *Senses*, which when a *man* perceives, he is apt to be troubled and peevish; and consequently is less disposed for his Studies, or other Affairs, that require a clear and serene *Mind*.

XIII. *Why the North-wind commonly brings fair weather, and the South-wind, Rain.*

Northern-winds do clear the *Air*, and cause *Fair-weather*.

Because by their impetuous *blasts* they drive away and disperse the *Clouds* that are already formed, and by their Coldness hinder the *Generation* of New ones: Whereas on the contrary, *South-winds* must needs produce a quite different Temperature in the *Air*, which is abundantly confirm'd by Experience in the *Isle of France*, *Burgundy* and *Campagne*, whither the *South-wind* always brings great *Rains*; for being opposed to the course of those *Vapours*, that are raised towards the *North*, and which blow towards the *South*, it stops them, and by its heat, doth in a short time change them into *showers*.

XIV. *Some winds blow only in some particular Regions.*

There are some *winds* that blow in some particular *Countries* only; as that *North-wind* which blows on the West-side of the *Alps*. Such also is the *North-east-wind* in *Apulia*, and in other places.

The Reason of these *VVinds* must be deduced from the *situation* of the several Places, the Narrowness of the *Valleys*, and the Caverns of the *Mountains*. For it is evident, that a *wind* must blow with greater violence between the Streights of *Mountains*, by the same Reason that the *water* of a *River* runs more swiftly where its *Channel* is streighteſt, because the Fore-parts of the *water* are prest forwards by those that are behind. And therefore it is, that a *VVind* that breaks from a streight place into an open *Country*, doth rage with an extraordinary violence.

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Why winds are most violent in the Winter.

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Why the South-wind is unreasonable ful.

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XV. *Why the North-wind is cold, and the South, hot.*

The *North-wind* is generally *Cold*, becauſe it paſſeth through a *Region* cover'd with *Snow*, whence it brings many *cold Vapours* along with it. But the *South-wind* is Hot, becauſe it comes to us from thoſe parts that are nearer to the *Torrid Zone*, whence it brings along many *hot Exhalations*, which the *Sun* hath call'd forth, which makes it to feel hot to us. This Mr. BOYLE made an Experiment of in a *Weather-Glaſs*, in which there was a hanging *Cylinder*, or long *Glaſs-Pipe* fill'd with *Water*, and after having blown into it with a pair of *Bellows*, the *water* did not fall down, as it happens when the *Cold* is increaſed; but on the contrary, the *Glaſs-Pipe* began to grow hot, and received ſome degree of *warmth* upon blowing in of the *wind*: But when the outſide of the *Bellows* was ſurrounded with a mixture of *Snow* and *Salt*, a colder *wind* came forth from it, and made the hanging *water* to deſcend. By which *Experiment* it ſufficiently appears, that all *winds* bring ſome *Steams* and *Exhalations* along with them, that impart a different Temperature to the *Air*, which they fan with their Blaſts.

XVI. *The Winds that blow in Temperate Zones are Irregular.*

The *winds* that bear ſway in theſe *Temperate Zones*, are generally irregular; that is, are tied to no certain *Rules* or *Laws*.

The Cauſe of this Inconſtancy is to be fetched from the different *ſituation of the Zones*; for ſeeing that the *Temperate Zones* are placed betwixt the *Torrid* and the *Polar frigid Zone*, they ſometimes receive the moſt intenſe *heat* from the former; and at other times, moſt extream *cold* from the latter. Whereas the *Cold* and *Hot Zones*, for the contrary Reaſon, are accuſtomed to more *Regular winds*, which at certain ſet-times uſe to be very violent. Thus becauſe *Southern-winds* with us, do moſt of all depend on the different force of *Exhalations*, therefore alſo they are free, and tied up to no *Laws*.

XVII. *Winds blow regularly only, on the Main Sea.*

But after all, it may be ſaid, that *winds* are ſcarcely Regular to exactneſs, ſave only on the *Main-Sea*, where the *Fermentations* that commonly happen in the *Earth*, cannot produce any Alteration; and that on the contrary, on the *Land* and in *Seas*, that are not very far from it, the *winds* muſt needs appear with all the Irregularities imaginable; not only with reſpect to the different parts of the *Horizon*, whence they blow, but alſo with reſpect to the force wherewith they exert their activity.

XVIII. *The moſt violent Winds are dry, and the moſt gentle are the moiſteſt.*

The moſt violent *winds* are ſuch as are dry; and the moſt gentle and ſoft, are thoſe that are moiſteſt.

The Reaſon is, becauſe the moſt violent *winds* are able to carry away with them the *watry particles* that are in the pores of *Bodies*, that are expoſed to their action; whereas on the contrary, the ſofteſt and gentleſt *winds* muſt needs be the moiſteſt; not only becauſe the *particles* of *Air*, and the *Vapours* whereof they are compoſed, are not of force enough to carry away the *particles* of the *water*, which are either in the *pores*, or on the *ſurface* of *Bodies* which they meet with; but alſo becauſe the *Vapours* which are in the *wind*, being only endued with a ſmall degree of *Agitation*, do ſtop at thoſe *Bodies*, and make them moiſt.

A *wind* blowing againſt a *Plate* of *Iron*, or a *wooden Board*, exerts but little force upon it; whereas when it is driven againſt the *Sails* of a *Ship*, it hath ſo great a force as to drive forwards the greateſt *Ships* ſo ſwiftly, as that they can run near 80 *Leagues* in 24 *Hours*.

XIX. *Why the Wind hath ſo great force againſt the Sails of a Ship.*

The Reaſon of this difference is to be aſcribed to the difference of the *pores* in theſe ſeveral *Bodies*; for thoſe that are in *Sails* are formed by the weaving of *Threds*, through which, when the *wind* paſſeth, it doth as it were divide it ſelf at the ſeveral *Threds* of the *Sail*, that ſeparate the *pores* from each other, and exerts its force againſt them: Like a Torrent of *water*, which exerts a greater violence againſt a Dam, that hath ſlits or intervals between them, than againſt a *wooden Board*, or a *ſtone Wall*, which affords no paſſage to any part of the *water*.

XX. *Why the Wind is felt colder than the Air, whereas indeed it is not colder than it.*

Winds ſeem to be colder, than the ſtill and calm *Air*, tho' they be little or nothing colder than it, as may be ſeen in a *Weather-Glaſs*, in which the *water* doth not mount higher when the *wind* blows, which yet ought to be, in caſe the *Air* that is ſhut up in the *Glaſs*, were made colder by the outward *wind*.

The Reaſon is, becauſe the *ſtill Air* doth only reach the outſide of our *Skin*, which being colder than the *Fleſh* which is hid under it, is therefore leſs ſenſible of the *Cold* that comes againſt it: Whereas the *wind* being more agitated, is driven deeper into our *Bodies*, and piercing the *Fleſh*, is conveyed into the Inward parts, which being much hotter than the *Skin*, are more ſenſible of the coldneſs of the *wind* that reacheth them. For the ſame Reaſon that a hot *Hand* is made ſenſible of more *cold* when it touches a piece of *Ice*, than a *Hand* which is only luke-warm.

CHAP. III.

Of Clouds and Miſts.

I. *How Clouds come to be poiſed in the Air.*

Clouds are ſuſpended and poiſed in the *Air*, tho' they ſeem to be thick and heavy.

The Reaſon is, becauſe the *particles* of *Ice*, or *Snow*, whereof they conſiſt, are very ſmall, and of much Surface, according to their bulk; and therefore are more hindred by the reſiſtance of the *Air* from falling downwards, than they are driven down by their own weight; much like as a heavy *loaden Ship* is born up by the reſiſtance of the *water* that ſurrounds it. Beſides, the *winds* that commonly blow near the *Earth*, conſiſting of a more thick and groſs Matter, than thoſe which are in the higher parts of the *Air*, are not only of force enough to ſtay and poiſe the *Clouds* in the *Air*; but alſo to raiſe them above that part of the *Air* wherein they are. Again, tho' the *particles* of *Ice*, being driven by the *wind*, do become contiguous to one another; yet are they not therefore cloſely joyned together, but on the contrary do conſtitute a *Body* which is ſo *looſe*, *light*, and *diffuſed*, that except *heat* do melt ſome of the parts of them, and by this means do condenſe and make them more heavy, they would never be able to fall to the ground.

Miſts

II. *Why there be more Miſts in the Spring, than at other times.*

Miſts are very frequent in the *Spring*, more than at other *Seaſons* of the *Year*.

The Reaſon is, becauſe at that time there is a greater *Inequality* between the *heat* of the *Day* and the *cold* of the *Night*; by which means it happens that a great quantity of *Vapours* do meet with the Coldneſs of the *Air*. For there are two things required to the turning of *Vapours* into *Water* or *Ice*: The firſt is, that their *particles* come ſo cloſe together, that they may touch one another: The 2*d* is, that there be Cold enough to ſtop and unite them, when they are come thus cloſe together. For the *Cold* would be of no uſe, if the *particles* of the *Vapours* were at a diſtance from one another, and ſeparated. And their *Connexion* would be of as little uſe, in caſe the agitation of *Heat* were ſo great to hinder their union. And therefore when in the *Spring*, *Vapours* are carried upwards by the *heat* of the Day, which by the *cold* of the following Night are again condenſed, it cannot be otherwiſe, but that *Miſts* muſt more frequently appear at that time, and the *Earth* be more abundantly moiſtned with them. And for the ſame Reaſon it is, that on the *Sea-Coaſt*, and in *Marſhy places*, *Miſts* are more frequently generated than in *Upland places*, and ſuch as are remote from the *Sea*; for the *Water* in thoſe places ſooner loſing its *heat*, than the *Earth*, imparts a coldneſs to the *Air*, where afterwards the *Vapours*, that proceed in great abundance from the *hot* and moiſt *Earth*, are condenſed.

III. *What is the Cauſe why one Cloud ſeems to lie upon another.*

Sometimes a *double* range of *Clouds* appear in the *Air*, whereof the one is carried below the other.

The Reaſon is, becauſe the *Vapours*, of which the *Clouds* are generated, do not with an equal force mount up into the *Air*, but ſome get up *higher* than others, before that they are ſufficiently condenſed for the forming of them. Whence it is, that we ſee ſome of them further from the *Earth*, and others nearer to it, and theſe too ſometimes driven by different *winds*. Which is more eſpecially perceived in *Mountainous places*, where the *ſublimed Vapours* are more unequally driven by the *heat*, than in other places. Hence it is, that according to the greater, leſſer, or equal weight of the *Cloud*, the ſame *Cloud* doth either aſcend, deſcend, or hang equally poiſed in the *Air*: As a *Ship*, according to her greater, leſs, or equal *weight*, doth riſe higher, ſink lower, or keep in an equal ſtation in the *water*.

IV. *The higheſt Clouds conſiſt of Icy particles.*

The higheſt *Clouds* are compoſed of *particles* of *Ice*, which may be gather'd from the Tops of the higheſt *Mountains*, which even in the midſt of *Summer* are cover'd with *Snow*.

The Reaſon is, the great Coldneſs of that *Region* of the *Air*, which without doubt is colder, than that which lies upon the tops of the *Mountains*, or at leaſt as cold; and becauſe the *Vapours*, the higher they aſcend, the more cold they meet with to condenſe them, and are the leſs liable to be preſſed by the *winds*; therefore, for the moſt part, do the higheſt parts of the *Clouds* only conſiſt of the thinneſt *Capillaments* of *Ice*, ſituate at a great diſtance from one another.

V. *What is the Cauſe of the various Colours of Clouds.*

Clouds appear of different *Colours*, ſometimes *black*, at other times *white*, and ſometimes are painted with all the *Colours* of the *Rain-bow*.

A *Cloud* appears *black*, when little or no *Light* is reflected from it, and then it is a ſign of *Rain*; becauſe the lower part of the *Cloud* is either already turned into *water*, or will be ſo ſuddenly. So on the other hand, when the *Light* is reflected from the *Cloud*, only by changing the Order of the *Rays* lighting upon the *Cloud*, without any other change of the *Beams*, then the *Cloud* appears *white*, and is a fore-runner of *Fair-weather*; becauſe the ſaid *Cloud*, conſiſting of diſtinct *Globuli*, or round *particles*, doth more readily vaniſh into the *Air*. And ſo laſtly, when the *Light* is reflected from a *Cloud* in the ſame manner, as it is ſent back from the Matter of a *Rainbow*; then that *Cloud* appears of many *Colours*, like a *Rainbow*, *viz.* Red, Green, and Purple, and may be a ſign of *Changeable-weather*.

VI. *Why Miſts commonly ariſe about the Morning.*

Miſts commonly are generated in the *Morning*, when a clear *Night* hath gone before, and when the *weather* is calm and free from the leaſt Blaſt of *wind*. And if any one of theſe be wanting, either no *Miſts* at all do ariſe, or if they do, they preſently vaniſh.

The Reaſon is, becauſe a *Miſt* chiefly riſeth from a *Vapour*, which breaks forth from the *ſurface* of the *Earth*, being raiſed by a gentle *heat*, from *Boggy places* and *Rivers*, eſpecially if they run ſlowly. Wherefore if the *Heat* be over-great, it doth too much dilate the *Vapours*, and makes them fly upwards and vaniſh away. The extream ſharpneſs of the *Winter coldneſs*, and great and violent *winds*, are alſo a hindrance to the production of *Miſts*, becauſe then the *Vapour* cannot be kept in by the ambient *Cold*, and the Thickneſs is loſt, which is neceſſary to the conſtitution of a *Miſt*. Moreover, a *Rainy* or *Cloudy Night*, hinders it, becauſe the *Rain* extinguiſheth that warmth which is neceſſary for the raiſing of *Exhalations*. Laſtly, When a *Cloudy Night* hath gone before, no *Miſt* will aſcend; for ſeeing that no *Dew* falls at that time, there is no matter for the raiſing of *Vapours*; and therefore it is neceſſary in order to the forming of a *Miſt* above the *ground*, that the weather be *ſtill* and calm, that the *Earth* be *warm*, and that a fair *Night* hath gone before.

VII. *Why a Miſt is dark and dusky.*

A *Miſt* is dark and dusky, and deprives us of the Light of the *Sun*.

The Reaſon is, becauſe a *Body* that conſiſts of many *particles* ſo ranged, that the *Light*, by reaſon of the ſaid parts lying one upon the top of another, is the leſs tranſmitted, the deeper it drives amongſt theſe little *Bodies*; ſuch a *Body* as this is, I ſay, tho' at firſt it be tranſparent, yet will at laſt, by this its ſwallowing up of the *Light*, become dark and dusky. For after this manner it is, that *beaten Glaſs*, *foaming Waves*, and a thick or cloſe *Wood* become Dark or Dusky. And the ſame is the caſe with a *Miſt*: For *water* attenuated into its leaſt *particles*, which is a *Vapour*, and the Matter of a *Miſt*, tho' with theſe its divided *particles* it be ſo toſt up and down in the *Air*, that it ſcarcely hinders the ſtrait courſe of the *Light*; yet when the ſaid *particles* come together again, it conſtitutes ſome Drops, which tho' every one of them ſingly taken be tranſparent, do ſo receive the *Light*, that not ſo much as one of the *beams* is tranſmitted or paſſeth through the whole heap of them.

When

VIII. *When a Miſt is a ſign of Rain.*

When a *Miſt* having its parts united is carried downwards it threatens *Rain*; but if it be rareſied by degrees, and ſo aſcend, it is a ſign of fair *Weather*.

The Reaſon is, becauſe when a *Miſt* in an united *Body* is carried upwards into the *Air*, it joyns to its ſelf many *particles* of *Dew*, which are ſcattered up and down the cold morning *Air*, which being ſoon after put into a motion by the leaſt heat, are diſſolved into *Rain*. Whence we obſerve that a *Miſt* is often ſuddainly raiſed, whereas the *Sky* before was very clear, and promiſed nothing leſs than *Rain*. For the heat agitating more forceably the little *drops* whereof the *Miſt* doth conſiſt, makes many of them to run together, into ſuch great *drops*, that the *Air* being no longer able to bear them up, they are forced to fall down in *Rain*.

IX. *Great Miſts and Clouds are generated by the meeting of two Winds.*

When 2 or more *Winds* meet one another in their courſe, then *Miſts* are formed in the place of their meeting.

The Reaſon is, becauſe theſe *Winds* drive many *vapors* together to that place, which being united do either form *Miſts*, if the *Air* thereabouts be very cold; or elſe produce *Clouds*, if the neighbouring *Air* be not cold enough to condenſe them, and ſo the matter of theſe *Vapors* mounting up higher into the *Air*, is there by the coldneſs of the place coagulated into *Clouds*. Yea, ſometimes ſuch a vaſt quantity of *Vapors* is gathered together in thoſe places where 2 or more *Winds* meet, that the *Winds* cannot paſs for them, neither above, nor under them, and ſo are forced to move round them, by which means they form a great *Cloud* of the ſaid *Miſty matter*, which being preſſed on all ſides by the *Winds*, gets a round and ſmooth ſurface.

X. *A Miſt magnifies and leſſens Objects.*

If a *man* be look'd upon through a *Miſt*, he appears like a *Giant*: Whereas the *Sun* being beheld through it, appears much leſs.

The Reaſon is, becauſe many *Rays* are refracted in thoſe *drops*, whereof the *Miſt* doth conſiſt, which being gathered within the *Eye*, do dilate and extend the Object. But the *Sun* appears leſs, becauſe the *Beams* proceeding from him, by reaſon of their great diſtance are diſſipated, and do not all of them light upon the *Eye*; ſo that ſome of the lateral *Rays* are loſt, which are wont chiefly to magnifie Objects.

CHAP. IV.

Of Rain.

I. *Why the Drops of Rain are round.*

DRops of *Rain* as they fall down do ſettle themſelves into a Round or *Globular figure*.

Some ſuppoſe this to proceed from an innate inſtinct in things, whereby they endeavour to preſerve themſelves from deſtruction; and that therefore the *drops* of *water* reduce themſelves into a round *figure*, the better to preſerve themſelves from the injury of the *Air*, or the action of any other *Body* coming in their way. But this is to attribute *Underſtanding* and *Will* unto inſenſible things. Say we rather that the *drops* of *water* become *ſmooth* and *round*, by means of the *Heavenly Globuli* which ſurround them, and thruſt themſelves within the *Pores* of them. And becauſe the *Heavenly Globuli* have another motion amongſt the parts of the *water*, than in the ambient *Air*, and endeavour to move in right lines, thus it comes to paſs, that thoſe of them which wander in the *Air*, are leſs hindered in their motion, when the *drops* of the *water* they meet with are *Globular*, than if they were of any other *figure*. Wherefore if any part of them chance to be prominent and not comporting with a *Globular figure*, the *Heavenly Globuli* in their Career through the *Air*, do with greater force daſh againſt theſe prominences, than againſt the other parts; and ſo drive them towards the *Center*. But if the ſaid part chance by this force to be driven too near the *Center*, then the *Heavenly Globuli* that are within the drop, do with greater force, drive it from the *Center*, and by this means it is that all *drops* of *water* are formed into an exact *Spherical figure*.

II. *Why Drops loſe their roundneſs when they run together.*

Hence it is, that when *drops* touch one another they loſe their *roundneſs*, and run together; for in the point where *drops* touch, the *Æthereal water* preſſeth them more weakly than in others, and doth not drive all the parts of them equally towards the *Center*, as it did before.

III. *Why it Rains ſometimes in the Summer when no Clouds appear.*

It happens ſometimes in the *Summer*, and in ſtill and calm *Weather*, accompanied with great and ſultry *Heat*, that *Rain* falls, before any *Cloud* can be ſeen.

The Reaſon is, becauſe the *Vapors*, which are then in great quantity in the *Air*, being preſt upon by the *Winds* of other places, as appears by the calmneſs of the *Weather*, and the ſultrineſs of the *Heat*, are turned into *drops* of *Rain*, which fall down as faſt as they are formed in the *Air*.

IV. *Why it doth not Rain in* Egypt, *and ſome other Countries.*

In ſome *Countries* it never, or very ſeldom *Rains*, as in *Egypt*, and more eſpecially the upper parts of it. And the ſame is alſo aſſerted by PLUTARCH concerning *Lybia*, and ſome *Countries* of *India*, which are always dry, and never refreſhed with any *Moiſture*.

I cannot conceive that this is to be aſcribed to the over-great *Heat* that reigns in thoſe *Countries*, ſeeing there be others that are much *Hotter*, where it doth *Rain*. Wherefore the cauſe of this want of *Rain*, may with greater probability be attributed to the *Dryneſs* of the *Earth*, and the diſpoſition of its parts, that have no water hidden under them, which being turned into *Vapors* might produce *Rain*; or if there be any ſuch *Moiſture*, yet becauſe of the over-cloſe compactneſs of the *Earth*, the ſame cannot get out into the *Air*. For as *Dogs* do never ſweat, becauſe of the compactneſs of their *Skins*, which is ſuch that they cannot make way for the *ſteams* to get through: So the ground of *Egypt* may be of ſuch a cloſe and compact texture, as not to have *Pores* large enough for the tranſmiſſion of *Vapors*. Neither can the *Eteſiæ*, which blow from the *Mediterranean Sea* towards *Egypt* conveigh any *Clouds* thither, that might turn to *Rain*; for it is not probable, that *Vapors* can be carried ſo far by the force of *Winds*; and beſides, theſe *Winds* are not continual, but altogether ceaſe at the firſt approach of the *Night*.

V. *Why Rains are more frequent in ſome Countries than they are in others.*

Rains are more frequent in ſome *Countries* than in others, as in *Languedoc* in *France*, and in *Ireland*, *&c.*

The Reason is, because the Situation of these *Countries* is such, that the *Clouds* which proceed more abundantly from the *Sea*, than the *Earth*, being full loaden by that time they come there, are forced to fall to the ground. It is found by experience in *Languedoc*, that the *Clouds* that come from the *West*, where the *Ocean* is, and those which rise from the *South*, where the *Mediterranean* lies, are so loaden with *Rain*, the former when they arrive in the upper *Languedoc*, and the other in the lower, that they can pass no further without falling down: But yet so as that those *Clouds* that come from the *Ocean*, do seldom come to the lower *Languedoc*, nor those from the *Mediterranean* to the upper; whence it is that it seldom *Rains*, with a *West* or *North-west Wind* beyond *Carcassone*, in the way towards the lower *Languedoc*; as it very rarely *Rains* with a *South Wind*, or *South-West*, beyond the same *City*, towards the upper *Languedoc*. And forasmuch as the force of these 2 *Winds* is spent about this place, it cannot be otherwise but that the *Clouds* must there fall down into *Rain*, which is the very reason why the *Rains* are so abundant about that *City*.

VI. *What is the cause of those continual Rains that fall betwixt the Tropicks.*

Between the *Tropicks* almost continual *Rains* fall from *July* to *September*.

The Reason is, because the *Sun* at that time doth extreamly rarefie the *Air* that is in the *Northern* part of the *World*, which makes the *Air* that is in the *South* part, to drive that way, and in its passage takes along with it all the *Vapors* that arise from the *Sea* of *Æthiopia* and the *East-Indies*, which are very copious, and being come between the *Tropicks*, where the *Air* is *hotter* than else where, they are forced to turn into many small *drops*, which falling down in *Rain*, abundantly moisten the *Earth*, and make the heat of those *Countries* the more supportable.

VII. *What is the cause of the raining of Milk and Blood.*

It *Rains* sometimes *Milk* and *Blood*. Thus PLINY tells us in the 56 *Chapter of his natural History*, that it rained *Milk* when M. *Acilius* and C. *Porcius* were Consuls. And LIVY makes mention of a *Bloody Rain* in his 4 *Decad. Book* 9*th* which fell for 2 *Days* together, in the Yard of the Temple of *Concord*. And amongst our modern *Authors* GEMMA FRISIUS relates *Libro* 2. *Cosmocrit. cap.* 2. that in the County of *Embden* in *East-Friesland* it rained *Blood* one *Night* in that abundance, that for the space of 5 or 6 miles all the *Herbs* and *Linnen Cloth*, and all things else exposed to the *Air*, were changed into the colour of *Blood*.

GASSENDUS supposeth *Milky Rain* to be nothing else, but a *Whitish water*, made so by the mixture of some *Particles* of *Lead*, *Sugar of Saturn*, *Saltpeter* and *Vinegar*, which are proper to tinge *water* of a *White colour*. And that a *Bloody colour'd Rain* proceeds from *Vitriolick* and *Bituminous Steams*, which impart a *Red colour* to the *drops* of *Rain*, as soon as they reach the ground. But it seems more probable, that these *Rains* are the product of *Vapors*, which proceed from places that abound with *Red-Lead*, or *Ruddle*: As *Historians* tell us, that *Red Snow* sometimes is seen to fall in *Armenia*, because of the *Red-Lead* wherewith that Country doth abound, or from places where much *Blood* hath been shed; or this *Red colour* may be occasioned by the extream heat of the *Sun*; as we see that the *Urines* of those who are sick of an *Ague* or *Fever*, look *Red*, and the water that is made to run through hot Ashes acquires the same *colour*.

VIII. *What is the cause of those Bloody spots, that are sometimes seen upon Stones*

Some are of Opinion that the *Bloody spots* which sometimes are seen upon *Stones*, do not proceed from any *Rain* of *Blood*, but are caused by *Caterpillars* which turn to *Butter-flies*, and upon the changing of their *Skin*, leave those *Bloody* spots behind them: Which they confirm by this, first, that these spots can scarcely be ever washt off with *water*; and in the next place, because they are never found on the tops of Houses, and very rarely in *Towns*, but frequently in the *Country*, and in those holes where *Caterpillars* commonly do nestle.

IX. *The cause of a Silver Rain.*

What some relate of a *Silver Rain*, is not so altogether improbable, that it should be rejected as fabulous; seeing it is possible for *Quicksilver* to be sublimed so high in the *Air*, as that afterwards it may fall down in *drops* again, which may very well by the common people be taken for *Silver drops*. And that this is the true cause of this kind of *Rain*, may be confirmed from what the *Historian* DION hath Recorded, that it *rained Silver* in the Reign of the Emperor *Severus*, which lighting upon pieces of *Copper* communicated the *colour* of *Silver* to them, which after 3 days time vanished again.

X. *Whether it be true what* Avicenna *relates, that a Calf rained down from Heaven.*

AVICENNA tells us, that a *Calf* fell down from *Heaven* to the *Earth* in a great *Storm* of *Rain*.

I do not think that AVICENNA ever supposed that this *Calf* could be produced in the *Clouds*, or that there is any matter in them proper for the *generation* of *Animals*: But only that the *Calf* might have been snatcht up with a Whirlwind, and cast down elsewhere with a *shower* of *Rain*. For the *Fluid* substance of *Heaven* is altogether unfit, for the forming of such *Bodies*; neither could a thing of that weight be kept up in the *Clouds*, but would fall down, before it was fully formed.

XI. *Of the Mouse called* Lemnar *which falls from the Clouds in* Norway.

And we are to pass the same Judgment, concerning that *Norway Mouse* called *Lemnar*; for tho' it be supposed to come down out of the *Clouds*, yet OLAUS upon dissecting of one of them found some *raw Herbs* in its *Stomack*, which is a pregnant Argument, that it was never generated in the *Air*, but snatcht up from the ground by some strong *Wind*, and carried into *Norway*, as it is certain that *Locusts* are sometimes after this manner carried from one place to another.

XII. *What is the cause of the Raining of Frogs.*

There is nothing more common amongst both antient and modern *Writers*, than the *Raining* of *Frogs*, wherewith the *Fields*, *Hills* and *Ways* have been frequently after such a shower, covered and annoyed.

Tho' I dare not absolutely deny, but that *Frogs* may be generated in the *Clouds*; yet neither can I wholly assent to those, who do so confidently assert it. My reason is, because we never read of their falling upon the *Tops* of *Houses*, or into *Rivers*, but either in the *high ways*, or other places abounding with dust, and perhaps their *Spawn*, of which, upon the falling down of the *Rain* it is probable they are formed. This conjecture of mine is confirmed by ÆLIAN in his 2 *Book of Animals Chap.* 5. *I remember*, saith he,

he, *that in my Journy from* Naples *towards* Dicæarcia, *it rained* Frogs, *that had their fore-parts formed, ſo that they crept with their fore-Legs, whilſt the hind part of them was nothing, but a muddy ſlime without form.* Which is a very pregnant Argument, that theſe *Frogs* were formed out of a *Seed* in the ſaid *Duſt*, mingled with the fallen *drops* of *Rain*, and that conſequently they had their riſe not in the *Clouds*, but on the *Earth*. Beſides, when ſhould the *Air* or *Clouds* be furniſhed with matter, proper for the generating of ſuch vaſt multitudes of *Frogs*? Or how could they be kept up in the *Air* without falling down? Or why ſhould they at laſt fall down, before they were perfectly and fully formed? Wherefore it is moſt probable, that theſe and all others that ſeem to come down from the *Clouds*, are generated in manner as above ſaid. Thus we ſee, that after the over flowings of *Rivers* many *Inſects* do ſwarm in the *Fields*: And that after *Rain*, a vaſt number of *Snails* are produced; ſo likewiſe *Oyſters* and other *Shell fiſh* are ſometimes formed of the *drops* of *Rain*, mixing with *Mud* or *Slime*.

XIII. *The Seed of Frogs may be carried up to the Clouds.*

Except it be ſaid that the *Seeds* of theſe *Animals*, being mingled with the *Vapors* or *Winds*, may be ſometimes carried up to the *Clouds*; as they are at other times to *Pools* and other places, abounding with *Mud* and *Moiſture*. As we read that *Coals*, *ſtanding Corn* and other ſuch like things, have been carried away by the *Wind* into other places, where falling down, the people concluded that it rained *Coals*, *Corn*, *&c.*

XIV. *But it is moſt probable that they are generated on the Earth.*

But indeed it ſeems more probable, that theſe *Frogs* were at firſt generated in *Ditches* or other places, but that at firſt they are ſo little as not to be perceptible by the *Eye*, they being for ſome days after they are firſt hatcht very ſmall without *Feet*, and with a long *Tail*, without bearing the leaſt reſemblance with *Frogs*; and do afterwards by degrees get *Feet*, and loſe their *Tails*. So that hiding themſelves under the *Hedges*, and under the *Graſs*, it is a difficult thing to diſcern them from the *Duſt* or *Mud* of the *Ground*; ſo that the *Rain* ſerves only to bring them forth out of their lurking Holes, and preſent them to our view. And that this is ſo, we have the greater reaſon to believe, becauſe *Food* hath been found in their *Stomacks*, and *Excrements* in their *Guts*. So that we may well conclude, that theſe *Frogs* are not then formed, but only do then firſt appear, tho' they were long before.

XV. *The Sun ſhining at a time when the Heaven is covered with Clouds, is a great ſign of Rain.*

The *Sky* covered with *Clouds*, is a ſign of *Rain*, tho' the *Sun* may ſhine very clear in the *Eaſt*.

The Reaſon is, becauſe there are no other *Clouds* in the Neighbourhood of our *Air* towards the *Eaſt*, which might hinder the *Heat* of the *Sun*, from condenſing thoſe that hang over our heads, or raiſe new *Vapors* from the *Earth*, whereby the ſaid *Clouds* might be encreaſed. But this cauſe taking place only in the Morning, if it doth not *Rain* before Noon, it can be no ſign of what will happen in the Evening.

XVI. *Signs of Rain taken from inanimate things.*

Other ſigns of approaching *Rain* are theſe; the *Sun* ſhining bright early in the Morning, or appearing of a *Blewiſh colour*; for this is a token, that there is great ſtore of *Vapors* in the *Air*. So likewiſe when the *Moon* appears of a *Pale colour*, it is a forerunner of *Rain*: And when the *Stars* ſeem to twinkle more than ordinary. *Yellow Clouds* alſo near the riſing of the *Sun*, are a *prognoſtick* of *Wet-weather*; but the ſame *colour'd Clouds* in the *Evening*, do promiſe *Fair-weather* the next day. For the *Vapors* at *Sun-riſing* are carried upwards, and are reſolved into *Rain*.

XVII. *Signs of the Weather appearing in Living Creatures, and other things.*

From other *inanimate things* and *Animals*, *Prognoſticks* may be taken of the changes of *Weather*; for the *ſubtil Vapor* which is diffuſed in the *Air*, enters into the *Pores* of their *Bodies*. Hence it is that *Doors* creak, that *Wood* laid upon the *Fire crackles*. And as for *Animals*, *Kine* lift up their *Heads* towards *Heaven*, *Gnats* and *Flies ſting* more violently, *Hogs* pick ſtraws, *Earth worms* creep forth out of the *Earth*, *Piſmires* retire to their hillocks, *Leeches* ſwim on the top of the *Water*, becauſe they then lye in wait for *Flies* and other *Inſects*, which the ſteams or *winds* do bear down toward the *Earth*. *Frogs* croak more frequently, becauſe they delight in a moiſt *Air*; or becauſe they are more preſt upon by the lowering *Clouds*.

XVIII. *Why the drops of Rain are greater in* Summer *than in* Winter.

The *drops* of *Rain* are commonly greater in the *Summer*, than in the *VVinter*.

The Reaſon is, becauſe the *drops* in the *Summer*, do fall down from a much higher place, and having a long tract to paſs through the *Air*, they grow bigger in their paſſage. For *Rain* falls from the *Clouds* 2 ſeveral ways, either when the *lower Air* by giving way, or the upper *Air* by falling upon the *Clouds*, doth give them occaſion to fall down. Wherefore when the *Air* that is under a *Cloud* doth contract it ſelf, then a ſmall *Rain* like duſt falls down upon the ground. So in *Egypt* no *Rain* is known, but what falls down in very ſmall drops. But thick *Rain* and violent *Showers* happen when a *Cloud* deſcends being born down by the *Air* that is above it; for then the *drops* of *VVater* falling down from a great *height*, do meet with other *particles* of *water*, and joyning with them become greater than they were before.

CHAP. V.

Of Hail and Snow.

I. *Why Hail falls more commonly in the day time than at night.*

HAIL falls more generally in the *day* than at *night*, and oftner in the *Spring*, *Summer* and *Autumn*, than in the *VVinter*.

The Reaſon is, becauſe a *Cloud* cannot be melted but by *Heat*, and therefore it is that *Hail* falls only at that time, when there is ſufficient *Heat* to produce this effect. Wherefore tho' *Hail* may be *generated* in the *VVinter*, *Spring*, *Summer* and *Autumn*, and in the *night*, as well as in the *day*; yet does it fall more ſeldome in the *night*, and in *Winter*, becauſe then the *Heat* is too weak to be reflected up to the higher *Clouds*, ſo as to diſſolve them into drops of *water* of which *Hail* is made.

II. *Why the leſs Hail-ſtones are Tranſparent and the greater Opake.*

Small Hailſtones are ſometimes Tranſparent; whereas the greater are only ſo towards the *Surface*, having ſome *Snow* within them, and are of a *white colour*.

The *Tranſparency* of *Hail* proceeds from the coldneſs of the *VVind*, which freezeth the *drops* of *water* into *Ice*. Becauſe in this caſe, the *Pores* remain much the ſame as they were before in the *water*;

water, through which the *Globuli* of the *2d Element* paſſing without hindrance, tranſmitted the action of *Light* every way in *Right lines*: As was ſaid before concerning *Glaſs*. But when the *cold VVind* approacheth the *Flocks* of *Snow*, that are not quite melted, it drives the *Heat*, that is, the moſt ſwiftly agitated *ſubtil matter* into their *Pores*; becauſe the *VVind* it ſelf, cannot ſo eaſily or ſo ſwiftly enter them as the *Heat* or *ſubtil matter* that is in the *Air* can. Now when this *Heat* is thus ſhut up within the *Pores* of theſe *Flocks* of *Snow*, it endeavours to approach their *Circumference*, rather than their *Centers*, becauſe the *ſubtil matter* (in the agitation whereof *Heat* conſiſts) is more freely moved there, and ſo proceeds to melt them more and more, before they begin to *Freeze* again, and the moſt *Fluid*, that is, the moſt agitated *particles* of *water*, which are elſe where found in the ſaid *Flocks*, approach to their *Circumferences*; the reſt of them, which cannot melt ſo ſuddainly, abiding about the *Centers* of them. Which is the reaſon, why the greater *Hail-ſtones* are *Tranſparent* towards their *Surface*, and inwardly of a *white colour*.

III. *What is the reaſon of the unuſual greatneſs of ſome Hailſtones.*

Sometimes *Hail* equal in bigneſs to great *Stones* falls down from *Heaven*. And I have heard an acquaintance of mine relate, that he had ſeen *Hailſtones* as big as *ten Eggs*. And *Hiſtorians* relate of ſome that were no leſs than a mans *Fiſt*. In the year 1666, in *Gelderland*, ſome were ſeen of about 3 pound weight.

This bigneſs proceeds from the *Cold VVind*, by which the *Hail* is formed, which driving the *Snow* downwards from on high, drives many of the *Flocks* of it together, and by means of the Cold condenſeth them into one *Maſs*. Or elſe we may ſay, that ſuch great *Hailſtones* are generated in the *higheſt Clouds*, and that they encreaſe continually all the way they come down, and by this means grow into a great and extraordinary bulk. For it may ſo happen, that they may meet in their way with much *moiſture*, which ſticking to them, may be *Frozen* into one *Maſs* with them. And by this means the *Hail* is encreaſed, by the addition of new *Surfaces* or *Coats*: As we find that *Candles* by repeated dipping into the *melted greaſe*, do ſtill grow thicker.

IV. *Why Hailſtones are of different figures.*

Hailſtones are ſometimes of a *Spherical figure*, and at other times appear under various configurations.

The Reaſon is, becauſe the *Flocks* out of which the *Hailſtones* are formed, being ſeized of the *Cold VVind*, are congealed by it. For if the *Cold VVind*, that is the efficient of *Hail*, meets with drops of *water* already formed, it makes the *Hailſtones round*, ſave only that it frequently makes them ſomewhat flattiſh on that ſide, where it drives againſt them. But if it meets with *Flocks* of *Snow* that are not quite melted, then it frames them into irregular *figures*.

V. *What is the reaſon of the great noiſe that is heard before the fall of Hail.*

Commonly before the *Hail* comes down, a great noiſe is heard in the *Air*.

This is cauſed when the *frozen drops* daſh againſt one another. And when this noiſe is heard ſome *interval* before the *Hail* falls, it is an Argument that the ſaid *Hail* is formed in the upper parts of the *Air*; ſo that there is no neceſſity at all in this caſe, to have recourſe to an *Antiperiſtaſis*.

VI. *How the Snow comes to be condenſed.*

We find by experience, that the *Snow* whereof the *Clouds* do conſiſt, becomes condenſed, and reduced to a leſs extenſion.

To apprehend this well, we need only to conſider that the *Heat* which commonly *rarefies* moſt *Bodies*, doth commonly condenſe *Snow*, the parts whereof are ſo ſcatter'd and divided, that the very leaſt agitation is ſufficient to bring them nearer together. Whence it comes to paſs, that when the *Air* which is ſo near to the *Earth*, and is always hotter than that which is at a greater diſtance from it, begins to raiſe it ſelf towards the *Clouds*, either by the driving of ſome *VVind*, or by the action of ſome new *Fermentation*, which cauſeth it to ſwell, it cannot but condenſe the *Snow*, whereof the *Clouds* do conſiſt.

VII. *What is the reaſon of Starry, Roſe-like and Hairy Snow.*

The *particles* of *Snow* are commonly figured like *Stars*, as may be perceived by catching the *Flocks* of *Snow* on a dry *Cloth*, and ſeparating the parts of it from one another: Tho' ſometimes alſo they be found *Hairy*, and ſometimes in the *figure* of *Roſes*.

The reaſon of this various *Configuration* is, becauſe the *Flocks* of *Snow*, before that they fall to the ground, do undergo manifold changes in the *Air*, and according to the viciſſitudes of *Heat* and *Cold* partake of different *figures*. *Starry figur'd Snow* is formed, when the *Leaves* of it, as the *Heat* approacheth, are melted leiſurely, ſo that the *Liquor* into which they are diſſolved ſpreading it ſelf over the *Surfaces* of the *Leaves*, doth fill up all the little inequalities it meets with there; and makes them ſo ſmooth and even, as thoſe parts of the *Liquid Bodies* are, tho' it preſently after *freezeth* there again. For ſeeing that the *Heat* then is no ſtronger, than what is required to reſolve thoſe ſmall *Capillaments*, on all ſides ſurrounded with *Air*, into *water*, the others ſtill remaining whole and entire; it cannot be ſtrong enough, to hinder that ſmall quantity of *water*, that is fallen upon their *Icy ſurfaces*, from being congealed again by *Cold*. Afterwards this *Heat* paſſing through other *Capillaments*, which every one of the *Flocks* of *Snow* have in their Circumference, where they are ſurrounded with 6 other ſuch like *Capillaments*, doth promiſcuouſly bend this way and that way thoſe *Capillaments* which are at the furtheſt diſtance from the 6 neareſt *Globuli*, and by this means joyns them to thoſe which ſtand over againſt theſe 6 *Globuli*. For theſe being kept *Cold* by the neighbourhood of the ſaid 6 *Globuli*, do not melt, but on the contrary do immediately *Freeze* or turn to *Ice*, the matter of the others that are joyned to them; and by this means 6 *Points* or *Rays* are formed about every one of the ſaid *Flocks*, which are capable of receiving divers *figures*, according as they are more or leſs compreſt, the *Capillaments* thick and long, and the *Heat* which forms them ſlow and moderate. Again, *Hairy Snow* is *generated*, when the *Icy particles* whereof the *Flocks* do conſiſt, are condenſed by the *Heat*, and ſoon after being *Frozen* by the *Cold*, are turned about their *Center*, and are bound up by other *Icy fragments*. So likewiſe *Snow* formed in the *figure* of *Roſes* is produced when the *Rays* that ſhoot out from the *Snow*, are bended by the *Heat*, and falling together with their points, are in that manner congealed again.

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VIII. *Why Snow is visible in the Night.*

The *Night*, which renders moſt other *Bodies* inviſible, hath not that effect upon *Snow*.

The Reaſon is, becauſe *Snow* conſiſting of an infinite quantity of little round *Bodies*, doth reflect the *Rays* of *Light* better than any other *white Body*. For tho' in the *Night* there be but a very weak and ſcatter'd *Light* ſpread over the *Earth*; yet there is that in *Snow*, which by a ſtronger Reflexion of it, doth make it ſelf viſible.

IX. *What is the Cauſe of the great whiteneſs that is in Snow, and why the ſame is changed when water is caſt upon it.*

An extraordinary *whiteneſs* is proper to *Snow*, which yet it loſeth, when mixed with *water*, and returns to *water*, whence it proceeded at firſt.

The Reaſon is, becauſe *Snow* is like a *Vapour* turn'd into *Froth*, the Flocks whereof conſiſting of innumerable *Globuli*, reflect the *Light* every way; foraſmuch as there is never a Point in all thoſe *Globuli*, from which *Rays* are not reflected to every Point of the *Medium*. And this is the Reaſon why *Snow* is hurtful to the *Eye-ſight*, becauſe that by reaſon of the foreſaid *Globuli*, it darts forth on all ſides a fuller and ſtronger *light*. Hence it is, that when we come into a Houſe, after we have walked through *Fields* cover'd with *Snow*, we cannot well diſcern the *Objects* we meet with. It is alſo found by Experience, that thoſe who live in places that abound with *Snow*, have weak *Eyes*; and ſome tell us, That *Souldiers*, by long Marches through places cover'd with *Snow*, have loſt their *Sight*.

X. *How the Snow comes to change its colour.*

But if the new fallen *Snow* ſeems to be of a *blackiſh Colour*, the Reaſon is, becauſe ſome Cavities are interſperſed between the *flocks*, which ſwallow up the *Rays*, and do not rebound them back into the *Air*. But *Snow* wholly changeth its *colour*, when mingled with *water*, which filling up the Cavities of the *Snow*, hinders the Reflexion or Refraction of the *Rays*, and cauſeth the *Light* to be modified after another manner. Hence it is that the *white Colour* of ſome *Fruits*, is only owing to the parts of it that are formed into *Bubbles*: For we ſee that *Apples*, when ſqueezed, loſe their *Colour*, becauſe theſe *Bubbles* being broken by this compreſſion, hinders that Refraction which is neceſſary to conſtitute a *white Colour*, as likewiſe ſuch a copious reflexion of *Rays*, as is requiſite to that purpoſe.

XI. *Why the handling of Snow makes the Hands to glow.*

Upon the handling of *Snow*, we find our *Hands* ſoon after to glow and *burn*.

Some ſuppoſe this to be done by an *Antiperiſtaſis*, becauſe when the *Cold* is driven out, *Heat* is introduc'd. But we own no ſuch Contrariety in *Nature*, and therefore rather conclude, that this *Heat* proceeds from the *Frozen particles* of *Snow*, which having the *watry humour* for their *Vehicle*, do enter into the *pores* of the *Hand*, beat back the *Blood*, and hinder it from being diſperſed through the *Veins* in the *Hands*; by which means the *Hands* ſwell, and appear of a *red Colour*. And therefore if we chance to put them to the *Fire*, we are ſenſible of a very ſharp pricking and ſhooting *pain*; for the *Fire* being forceably thruſt into their *pores*, doth dilate the *Icy particles* more than ordinary, and doth not drive them thence, without ſome twitching of the *parts*. Wherefore we ought to keep our *Hands* in a moderate warmth, to grow *hot* by degrees, and ſo be reſtored to their former condition.

Snow, tho' it be a *Frozen-water*, yet doth warm the *Earth*, and keeps the *Corn* from *freezing*.

XII. *Snow preſerves the Corn in the Ground from being frozen.*

The Reaſon is, becauſe the *pores* of *Corn*, that is cover'd with *Snow*, having been drawn together by the fore-going *Froſt*, and the Matter of the *2d Element*, endeavouring to enter through them, as ſoon as it begins to *thaw*, would not fail of rending the Texture of its parts, if it were not hindred by the preſence of the *Snow*, which having nothing in its *pores*, beſides the moſt *ſubtil matter* of the *2d Element*, can eaſily open again the *pores* of the *Wheat* by degrees, without tearing them, till they be open'd large enough to let the biggeſt Matter of the *2d Element* paſs through them.

XIII. *How Snow conduceth to make the Ground fruitful.*

Snow doth alſo contribute to the making of the Ground *fruitful*, if it lye on for ſome time, and be diſſolved by degrees.

The Reaſon is, becauſe when *Snow* covers the the *Ground*, it keeps in the *Alimental Juice* of *Plants*, and hinders the ſtrength of the *Ground* from evapourating into Steams and *Exhalations*. And therefore *Countrymen* tell us, that their *Grounds* yield a more abundant Increaſe, after they have been a long time cover'd with *Snow*, becauſe it keeps back thoſe fat *Exhalations*, which would otherwiſe break forth, and turns them into *Aliment* for the *Fruits* of the *Earth*. Or, it may be ſaid, that the *Snow* melting by degrees, doth afford a fat and cheriſhing *Moiſture* to the *Plants*, whereby they are fed, and become more vigorous. As is manifeſt when the *Snow* is thaw'd, and the *Earth* expos'd again to the *heat* of the *Sun*; and therefore it frequently happens, that in thoſe *Mountains* that are cover'd with *Snow*, the *Exhalations* that break forth, do make a kind of *Arch* or *Cruſt*, under which the *Graſs* ſprings forth very thick.

XIV. *How Snow may be hurtful to the Roots of Plants.*

I know well, that ſome *Phyſicians* are of another Opinion, who order *Gardiners*, to cover the *ſurface* of the *Ground*, in which *Plants* are ſet, with *Stubble* or *Straw*, to preſerve it from the injury of the *Snow*: But I ſuppoſe they do not give theſe Inſtructions, becauſe they ſuppoſe the *Snow* to be prejudicial thereunto, but leſt the *Roots* being throughly moiſtned by the *thawing* of the *Snow*, a ſharp *Cold* or *Froſt* following upon it, might freez the *Juice* within their *pores*; ſince it is evident, that the *Roots* of Plants throughly ſoak'd therewith, do preſently dye; nothing being more hurtful to *Plants*, than melted *Ice* or *Snow*, to chil and kill the *Roots* after a cold *Thaw*.

CHAP. VI.

Of the Dew, Hoar-froſt, Honey and Manna.

I. *Why the Dew is more copious in moiſt, than in dry places.*

THe *Dew* is obſerved to be more copious in *moiſt* and *mooriſh Places*, than in dry. Hence it is that the *Banks* of *Rivers* are commonly cover'd with *Dew*, when in dry and barren places there is no appearance of it.

The Reaſon hereof is commonly aſcribed to the *Vapours* which mount up from the *Earth* in great abundance, about the Banks of *Rivers*, and being

raiſed a little way up into the *Air*, do fall down to the ſame place whence firſt they broke forth. But I cannot altogether concur with this Opinion; foraſmuch as the higheſt *Mountains* are in the *Summer* moiſtned with *Dew*, and in the *Winter* cover'd with *Hoar-froſt*. For *Vapours* are not only condenſed near the *Earth*, but alſo on high in the *Air*: For thoſe which are carried up a great height by the *Sun*'s force, are afterwards by the *cold* of the *Night* condenſed and turned to *Dew*. And whereas *Shoars* are more abundantly cover'd with *moiſture* at Break-of-Day, than other more dry places; the Reaſon is, becauſe the *dry Earth* drinks up the Drops of *Dew* as faſt as they come down upon it, and does not ſuffer them to be condenſed on the *ſurface* of the *Ground*. But *Shoars*, or the *Banks* of *Rivers* being, as it were, glutted with *moiſture*, do not take in the *Dew*, but leave it on the *ſurface*. Thus the drops of *Dew* run together upon *Cabbage-Leaves*, becauſe their *ſurface* is ſomewhat *fat* and *oily*; but are immediately drunk up, when they light upon *Sand*.

II. *Why the Dew is more copious in the Spring and Autumn, than at other times.*

The *Dew* is obſerved to fall more copiouſly in the *Spring* and *Autumn*, than in the *Winter* or *Summer*.

The Reaſon is, becauſe in the 2 former *Seaſons*, the *heat* of the *Sun* is ſtrong enough to raiſe *Vapours*, and the *cold* of the *Night* ſufficient to condenſe them; whereas in the *Winter*, the *Plants* being depriv'd of their *Leaves*, are no longer able to turn the *Vapours* that light upon them, into little *drops*: And the *heat* is ſo violent in the *Summer*, that the *Vapours* can't be ſufficiently condenſed, by the *cold* of the *Night*, to fall down again into ſmall *drops*.

III. *Why the Drops of Dew are round.*

The *drops* of *Dew* are Round, or at leaſt reſemble the *figure* of an *Hemiſphere*.

The Reaſon is, the motion of the *particles* of the 2*d Element*, which equally puſhing upon all the parts of the *drops* of *Dew*, makes them to be equally diſtant from the *Center*. For as the *water* of a *River* running freely through the *Herbs* it meets with in its courſe, is ſo diverted by the *Stones* that interrupt its Current, that re-bounding upon it ſelf, it makes ſeveral little *Whirl pools*: So the *Globuli* of the 2*d Element*, freely flowing through the *Earthy parts* wherewith they are interrupted, their *fluid parts* are ſo diverted by the *Air* that meets them, that turning into a *Round drop*, they drive the *Terreſtrial parts* of the ſaid *Drop*, with an equal force towards the *Center*. For then any *liquid Body* becomes *round*, when all the parts of the Circumference of that *Body*, being driven with equal force, are at an equal diſtance from the *Center* of that *Body*.

IV. *When no Dew is found upon the Ground in the Morning, it is a ſign of Rain.*

If in the Morning the *Ground* be not ſprinkled with the *Dew*; and that the *Miſt* which is wont to moiſten the *Earth*, is carried upwards, and leaves the *Earth* wholly dry, this is a ſign of *Rain*.

The Reaſon is, becauſe this can ſcarce happen, but when the *Earth* hath not been ſufficiently cooled in the *Night*, or over-heated in the *Morning*, and therefore ſends forth many *Vapours*, which driving the *Miſt* upwards, cauſe the *Drops* of it to run together, and by this means become ſo thick and heavy, that ſoon after they are forc'd to fall down in *Rain*.

V. *Why the Hoar-froſt makes ſome Herbs more tender.*

The *Hoar-Froſt* is obſerved to make ſome *Herbs* more tender, as *Coleworts*, and the like, which being in *Winter* expos'd to the Air, become more ſhort and tender.

The Reaſon is, becauſe the ſupervening *Cold* doth conſtringe, and, as it were, draw together thoſe *Herbs*, and by bringing together their *particles* nearer to one another, doth quite change the order and ſituation of them. So as that having already undergon this preparatory Alteration, when the *Culinary fire* begins to act upon them, their Texture is eaſily broken, and their *Fibres* being before leſſened, and in part *diſſolved*, are wholly ſeparated from one another. Thus *Fleſh*, expoſed to the *cold* of the *Night*, becomes alſo more tender, becauſe the parts of it being more cloſely joyned and drawn together by the *cold* are afterwards ſlackned by the *heat*, and more readily comply with its motions.

VI. *Why the parts of Hoar-froſt hang together.*

The *parts* of *Hoar-Froſt* ſtick together, the contrary of which we Experience in *Hail*; which is diſtinguiſh'd into ſeveral *Stones*, which have no Connexion at all together.

The Reaſon is, becauſe *Hail-ſtones* falling from on high, as ſoon as they are come to the inward Tract of the *Air*, becauſe of the great *heat* they meet with there, their outſides begin to *melt*, and loſe their prominent *particles*, which make them rough; but the caſe is not ſo with the *Hoar-Froſt*, which always retains its ſharp-pointed *protuberances*; and therefore the *particles*, by reaſon of this their *Roughneſs*, are eaſily entangled and cling together. To which may be added, That the *Hoar-froſt* conſiſts of a more viſcid or clammy ſubſtance, than *Hail*; becauſe the *Rain*, whereof *Hail* is made, is meer *Water*, which preſently mounts up into the *Air*: Whereas the *Hoar-froſt* is a kind of condenſed *Dew*, which is much fatter than the *Rain*, as being made up of diverſe *particles*, proceeding from *Animals*, *Plants*, and *Things dug out of the Ground*. Now it is manifeſt, that a *moiſture* that is extracted from ſuch great variety of *Bodies*, muſt needs be more clammy, than a pure *watry Humour*; which is the reaſon why the parts of *Hoar-froſt* cling together, whereas *Hail-ſtones* are all ſeveral.

VII. *How Honey is made by Bees.*

Thoſe who give their minds to *Husbandry*, and more diligently ſearch into the Miracles of *Nature*, obſerve that *Bees* do in a very ſhort time make *Honey*, and fill their *Hives*. Some, who have been very exact Obſervers of the Labour of *Bees*, have obſerved, that the *Bee-Hives* are ſometimes quite Empty in the beginning of *May*, and within a ſhort time after have found them fill'd up with *Honey*.

It is not yet certainly known, whether the *Bees* draw that *Juice* out of *Flowers*, which of it ſelf is preſently turned into *Honey*; or whether they themſelves, by an inborn Natural property, do tranſmute the ſaid *Juice* into ſuch a *Taſte*, and other *Qualities*, as conſtitute *Honey*. Some are of Opinion, that *Bees* have not the Faculty to make *Honey*, but only the *skill* of gathering it. Whereas others ſuppoſe them endued with a Virtue or Faculty, whereby they turn the *Juice* they ſuck from *Flowers* into *Honey*. And I readily agree with thoſe that are of this latter Opinion; for I find that *Animals* tranſmute the reſidue of their *Aliment* into *Milk*, in their *Breaſts*, whereby it becomes changed

To the Worship-full Francis Gosfright of the Citty of London Esq.

This Plate is humbly Dedicated by Richard Blome.

changed into a new kind of Subſtance. And why may not the *Bees*, in the ſame manner, after that their *Bodies* have been nouriſhed with ſome part of the *Aliment*, tranſmute the Remainder of it into *Honey*, which they daily hoard up in their *Hives*. It is a difficult thing to find by Experience, whether they caſt up the *Juice*, which they draw from *Flowers*, through their *Mouths*, or evacuate it from any other part; tho' it ſeem more conſonant to Reaſon, that they evacuate it backwards, eſpecially if it be elaborated in their *Stomachs*. Neither doth it hinder the Truth of this Aſſertion, that *Bees* very greedily lick up the *Honey* they meet with in any place, and leaving their *Flowers*, betake themſelves to it; becauſe they deſire it as their proper *Food*, wherewith they are ſuſtained, and which, when they have lick'd in, they do convert again into other *Honey*. As *Women* that give Suck to *Children*, do alſo take in *Milk* for their Nouriſhment, and after it hath been digeſted in their *Stomachs*, do in their *Breaſts*, turn it into a new ſort of *Milk*.

VIII. *Why Honey is not gather'd in all places.*

Tho' *Honey* be made of *Dew*, yet is it not gather'd either by *Bees*, or *Men*, from *Plants*, in all places.

The Reaſon is, becauſe theſe *Exhalations* do not every where meet with ſuch a diſpoſition, as is proper to retain them; for ſeeing that the moſt *clammy* and *Earthy particles* of the *Dew*, are the chief Matter of *Honey*, and that theſe can only be gather'd in *dry places*, we cannot think it ſtrange that theſe are not found on the *moiſt Leaves* of ſome *Plants*. Hence it is that *Bees* do not gather their *Honey* very Early in the *Morning*, but after that the *watry Vapours* have been diſperſed by the *heat* of the *Sun*.

IX. *What is the Reaſon of the difference of Manna in ſeveral Countries.*

Manna is very different, according to the *Countries* where it falls, and is only gather'd from the *Leaves* of ſome certain ſort of *Trees*. PLINY's Opinion is, that it is moſt commonly coagulated upon *Oaks* or *Lime-Trees*. In *Calabria*, it is chiefly found on *Aſh-Trees*, and in *Syria*, on *Cedars*.

The Reaſon is, becauſe *Manna* is only coagulated on the *Leaves* of *Trees*, which contribute much to its conſiſtence and hardneſs. For ſeeing that *Manna* only conſiſts of *Exhalations*, its *particles* are of ſuch *figures*, that they cannot ſo well ſtick cloſe to the *Leaves* of other *Trees*. And therefore the Lord BACON tells us, that the Country of *Calabria* affords the beſt *Manna*, and in the greateſt plenty; for he ſuppoſes, that there is a kind of Coagulating virtue in the *Leaves* of *Mulberry-Trees*, on which it is commonly gather'd, whereby the *Dew* is thickned. Which *Virtue* he is the rather inclin'd to attribute to the *Mulberry-Leaves*, becauſe they are *rough* and *hairy*, and therefore very proper to retain a *Liquor* that lights upon them. But yet this *Juice* muſt not be confounded with *Honey*, foraſmuch as it is of a different Nature, and different Efficacy: For *Honey* doth ſtimulate and increaſe *Gall*, whereas *Manna* drives it out of the *Body*; for the *Nitrous Salt*, which *Manna* is not deſtitute of, doth provoke Nature to evacuate by Siege.

CHAP. VII.

Of Storms and Thunder.

I. *Storms at Sea are more violent than about the Shoar.*

THE ſame *Storms* rage more violently on the *Sea*, than on the *Land*.

The Reaſon is, becauſe the *Vapours* that are ſublimed from the *Waters*, are more moiſt and groſs, than thoſe that breath forth from the *Earth*, and that proceed from *dry Bodies*. Hence it is that thoſe Steams carrying more *Air* and *Exhalations* along with them, do furniſh *Matter* for the ſtrongeſt *Winds*. And for the ſame Reaſon it is, that *Winds* in all places are not endued with the ſame *Qualities*; but thoſe which are *dry* in one *Country*, may be *moiſt* in another. Thus it is obſerved, that *South-winds*, which generally in all places are *moiſt*, yet are *dry* in *Egypt*, where the dry *Deſarts* of *Africa*, parch'd with *heat*, and deſtitute of all *moiſture*, ſupply the Matter of them.

II. *Why Swallows, upon the approach of a Storm or Tempeſt, fly near the Earth.*

Swallows, upon the approach of a *Storm*, fly near the *Earth*.

The Reaſon is, becauſe the *Clouds* which then fall lower, and preſs down the intervening *Bodies* with their weight, drive the *Flies*, which *Swallows* feed upon towards the *Earth*, which in *Fair-weather* are wont to fly aloft in the *Air*.

III. *What is the reaſon of thoſe dreadful Storms called* Travados.

The *Sea* doth never Rage more dangerouſly, than in thoſe *Storms* which are called by the *Portugueſe*, *Travados*, theſe of all other being moſt formidable to *Sea-men*.

Theſe *Tempeſtuous Guſts* are chiefly perceived beyond the *Cape of Good-Hope*, becauſe there, the *Vapours*, which in great quantity are raiſed from the *Sea* of *Ethiopia* (as being of a vaſt extent, and expoſed to the greateſt *heats* of the *Sun*,) can eaſily produce a *Weſt-wind*, and ſtop the violence of thoſe *Vapours*, which proceed from the *Indian-Sea* that is oppoſite to it; and by this means drive them together into a *Cloud*: Which *Cloud*, ſince it riſeth from the Inequality that is interpoſed between thoſe two great *Seas*, and this Tract of *Earth*, which is alſo of a vaſt breadth, muſt of neceſſity be of a greater bulk, than that which is formed in our *Regions*, where it depends only on thoſe leſſer Inequalities, which divide our *Champion Countries*, and ſeparate *Lakes* and *Mountains*: So that this *high Cloud*, having acquir'd a great weight, doth fall down all together, and driving the *Air* before it, raiſeth a great *Tempeſt*, which commonly is ſo much the more vehement, the leſſer the *Cloud* did appear at firſt; becauſe it is ſuppoſed to be very high, and at a greater diſtance from the *Earth*. Now it is evident, that the force of a *Ponderous Body*, is by ſo much the ſtronger, by how much higher the place is whence it deſcends, and the greater the Space is it runs through.

IV. *In what Places theſe Tempeſts are moſt frequent.*

Theſe *Storms* are frequent about the *Equator*, eſpecially in thoſe Months in which conſtant *Winds* are leſs frequent. They are very common upon the Coaſt of *Guinea*, and at the firſt their Force is very violent, and by the help of them *Sea-men* often paſs the *Line*, foraſmuch as the ſetled *Winds* are now and then wanting in the Months of *April*, *May* and *June*, and alſo at other times. Wonderful *Storms* of this kind do alſo happen in the Entrance

trance of the Sea of *Arabia*, when a thick and black *Cloud*, mixed with a number of *Flame-colour'd* little *Clouds*, like a *Burning-Furnace*, vomiting thick *Smoak*, darkens the Day, whereupon a ſudden and moſt vehement (but not long laſting) *Storm* ariſeth, which caſts down a great quantity of red *Sand* upon the *Land* and *Sea*.

V. *Whence proceeds that boyling of the Waters, which is obſerved in the Gulf of* Lions, *and in the* Garonne.

In the *Gulf* of *Lions* the *Waters* are ſometimes as much agitated, as in the moſt violent *Storms*, tho' the Air be very calm.

This extraordinary Agitation proceeds from thoſe *Vapours*, which penetrate quite through the *Waters*. For it cannot be queſtion'd, but that there is an inward *Heat* at work under the *Sea*, beſides that of the *Sun*, which looſens, or ſets at liberty a vaſt number of *Vapours* and *Exhalations*, which proceed with extraordinary precipitancy, and in great abundance from the ſaid *Gulf* of *Lions*. And from the ſame Cauſe we may deduce the Boyling or Agitation that is obſerved in the River *Garonne* in *France*, near to *Bourdeaux*, which is an infallible prognoſtick of a certain *Wind* called *Maſcaret*; and conclude it to be produc'd by *Vapours* or *Exhalations*, which ferment or work ſucceſſively from *Bourdeaux*, towards the Head of the *River*; as that Ebullition which is obſerved in the *Gulf* of *Lions*, is cauſed by the *Vapours* and *Exhalations*, which in that part mount up in great abundance through the *Sea*.

VI. *What is the Cauſe of thoſe Hurricans that happen about the* Caribby *Iſles.*

Hurricans are very frequent in ſome of the *Caribby Iſlands*.

The Reaſon is, becauſe many *ſulphurous* and *Nitrous Exhalations* are ſublimed from divers parts of the *Earth*, that lies below that *Sea*, which do agitate the *Waters* with that extream Violence. Whereof this is a pregnant Inſtance, That after every *Hurrican*, a vaſt number of *Fiſhes* are found dead; which ſhews, that the *Waters* have been violently daſh'd together, not only on the *ſurface* of the *Sea*, but at the bottom alſo.

VII. *Of* Caſtor *and* Pollux, *and why they are accounted to be ſigns of a happy Voyage by Sea-men.*

It ſometimes happens in great *Storms*, that certain *Meteors*, in the appearance of *Fire*, fix themſelves on the Tops of *Maſts*, which are called by Sea-men *Caſtor* and *Pollux*, if there be two of them; but if only one appears, it is called *Helen*: The former being look'd upon to be a happy Omen; but the latter, unhappy; as portending an increaſe of the *Storm*.

Theſe *Fires* are produc'd by *Exhalations*, which are mix'd with *Vapours*, that compoſe a *Cloud*; which, foraſmuch as by reaſon of the ſolidity of their *parts*, and their irregular *figures*, they cannot be puſht forwards by the falling *Cloud*, with the ſame force as the *Vapours* are, by the motion of the *Air*, are ſeparated from them: And accordingly theſe *Exhalations* being united into ſeveral Curles, flying as high as they can along with the *Cloud*, meeting with *Ships* in their way, ſtick to the *Maſts*, or to the *Tackle*; the *Cloud* in approaching to the end of its motion, driving them down thither. And the Reaſon why two of theſe *Fires* are a ſign of better Hope, is, becauſe *Storms* are commonly more violent towards their going off; and therefore when theſe *Fires* are more than one, the *Tempeſts* are broken, and many *Clouds* lying one upon the top of another, are in a ſhort time diſperſed. But when a *ſingle Fire* appears, a greater *Storm* is to be look'd for, becauſe there may be many other *Clouds* remaining, which falling down, may with renewed Violence daſh the Waves together.

VIII. *Why Thunder is more frequent in Summer, than Winter.*

Thunder is much more frequent in *Summer* than *Winter*.

The Reaſon is, becauſe *Thunder* is cauſed after the ſame manner as *Storms* are, *viz.* by the falling of *Clouds* one upon another, that is, when the higher *Clouds* ruſhing down violently upon the lower, do produce that Noiſe in the *Air*, we call *Thunder*. Now this could not happen, if a warm *Air* ſurrounding the Upper *Clouds*, did not by degrees condenſe them, and make them more heavy. And ſeeing that in the *Winter*, a *heat* ſufficient to melt the Upper *Clouds* cannot get up ſo high, it is evident that *Thunder*, for this Reaſon, muſt be more frequent in *Summer*.

IX. *What is the Reaſon of the different Noiſe that is made by Thunder.*

The Noiſe cauſed by *Thunder* is very different; and doth not always ſtrike our Senſe of *Hearing* alike; for ſometimes it repreſents a continual Rumbling, and at other times the repeated Diſcharges of Great *Guns*.

The continued *Noiſe* is to be aſcribed to the various Reflexion of *Bodies*, and the Reſounding of the ambient *Air*. For as the Noiſe caus'd by the Diſcharge of a Great *Gun*, is heard with a continued noiſe or rumbling, becauſe of the *Hills*, *Buildings*, and other things, that beat back the *Sound*: So the rumbling Noiſe of *Thunder* is continued the longer, becauſe of the *Air* that every way ſurrounds it, and the *Bodies* that are ſo diſpoſed to reverberate it. And whereas *Thunder* ſometimes gives different and *interrupted Claps*, the Reaſon is, becauſe the parts of the higher *Clouds*, do either all of them fall down together, or one after another; or more ſlowly or ſwiftly; or, for that the lower *Clouds* are greater or leſs, thicker or thinner, and ſo make more or leſs Reſiſtance.

X. *Why Thunder commonly ceaſeth after a great ſhower of Rain.*

After a great *Shower* of *Rain* commonly the *Thunder* ceaſeth.

The Reaſon is, becauſe the Upper *Cloud* falling upon the Lower, is of ſuch force as to caſt it wholly down; and tho' perhaps it be not of force enough to drive it down altogether, yet it ſhakes out ſome *flocks* of *Snow*, which paſſing through the warmth of the lower *Region* of the *Air*, are turned into *Rain*. And it is for the ſame Reaſon, that *Men* endeavour to abate the violence of *Thunder* by the diſcharging of *Guns*; for the *Snow* being ſhaken by the agitation of the *Air*, is diſcuſt, and forced to deſcend.

XI. *Why a great Noiſe diſſipates Thunder.*

But we are here to obſerve, that tho' the Diſcharging of our Great *Guns* be uſeful to diſpel *Thunder*, when the *Clouds* are ſomewhat remote from the places where the ſaid *Noiſes* are made; yet is the effect quite contrary, when the *Clouds* are directly over againſt thoſe places.

The Reaſon is, becauſe when the *Clouds* that carry the *Thunder*, are at ſome conſiderable diſtance, the agitation of the *Air*, cauſed by the *Sound* is capable to diſperſe them, or at leaſt to oppoſe their approach; but when they are juſt over againſt the places where the *Guns* are diſcharged, the *Air* being ſhaken by their Sound, and daſhing againſt the lower part of the *Clouds*, weakens them, and ſo determines them to break at the bottom, and to let the *Lightning* eſcape.

The

XII. *Why the Thunder is always heard after the Lightning, tho' indeed it be before it.*

The *Lightning* is much more swift than *Thunder*, and therefore is always seen before the other is heard, tho' indeed the *Thunder* is ever before the *Lightning*.

The Reason is, because the *Sight* is performed by the help of the *Heavenly Globuli*; which being solid, and not capable of any division, do neither waver nor turn aside: Whereas the *Hearing* is performed by the *Tremulous Agitation* of the *Air*, whose *particles* being very flexible, and separated from one another, do bend upon themselves and waver, not having the direct steadiness of the *Globuli* of the Second *Element*.

XIII. *Why fermented Liquors are apt to turn sower after Thunder.*

The *Noise* and Concussion of the *Air*, caused by *Thunder*, makes *Wine* and other fermented *Liquors* to be troubled, and change their former *Qualities*.

The Reason is, because *Fluid Bodies* are not moved of themselves, but receive their agitation from the intercurrent *subtil matter*, wherefore also their *motion* must necessarily be proportionate to the Agitation of the said *Æthereal Matter*. And forasmuch as when the *Æther* is shaken with *Thunder*, the *matter* that is intercepted between the *Pores* of it, is very much dissipated, and put into irregular *motions*; thereupon the *particles* of the *Liquor* are also variously tost and bent, and by this means do introduce a confusion in it. Thus *Physicians* also observe, that tho' the *Blood* be not changed at all as to its outward appearance, yet it contracts a malignant *poisonous quality*; or on a suddain causeth a *Fever*, and this meerly from the disturbed motion of the *subtil matter*, which in a confused manner agitates the whole mass of *Blood*.

CHAP. VIII.

Of Lightning and Thunder-Bolts.

I. *Why the Lightning commonly strikes Steeples and Tall Trees.*

High Places are more frequently struck with *Lightning*, than low and level *Grounds*. Hence it is that *Mountains* feel more its effects than *Valleys*; and that the tallest *Trees* are most obnoxious to be hurt by it.

The Reason is, because *Lightning* consists of kindled *Exhalations*; which because of their loose *Texture* and volatility, are distinguisht from *Vapours*, and therefore rushing down towards the *Earth*, must rather strike the tops of *Steeples* and *Mountains*, than lower places. For the *Lightning*, upon the breaking of a *Cloud*, doth commonly dart forth from that part of it, which is most weak, and least able to resist the force of it: And seeing that *Steeples*, *Rocks*, *Mountains* and other *Eminences* do most of all oppose it, therefore the *Clouds* are most easily broken by meeting with such like *Bodies*, and consequently also discharge their force and violence against them.

II. *Why the Bodies that are struck with Lightning, do tremble a little before.*

Things that are *struck* with *Lightning*, do tremble before they are smitten, being shaken by the *Wind*.

The Reason is, because when ever this *Fiery Exhalation* is darted from any *Cloud*, at the same time a great quantity of the *Air* that lies between the *Clouds*, is pusht away together with it: Which *Air*, as the Forerunner of the *Lightning*, shakes high *Steeples*, lofty *Mountains* and tall *Trees*, as being nearer to it, before the *Lightning* can reach them.

Sometimes there is a *Stone* generated by the *Lightning*, which is discharged together with it from the *Clouds*, which is commonly called the *Thunder-Bolt*; because it breaks all *Bodies* it meets with, and casts them down.

III. *What is the cause of the Stone, which is produced by Lightning, and is commonly call'd the Thunder Bolt.*

This happens when many *Fat* and *Sulphureous Exhalations*, consisting of thick and dreggy *parts*, and like unto the setling of those *Vessels* wherein *Rain water* hath stood for some considerable time, are joined with those that form the *Lightning*. For as Experience informs us, that if we mix a certain proportion of *Saltpeter* and *Brimstone* with this *Earth* or *Mud*; and then set this mixture on *fire*, it will in a moment be turned into a hard *Stone*: So in like manner we may conclude, that a *Thunder-Bolt* is generated of *clammy* and *Terrestrial Exhalations*, mingled with *Brimstone*, which it may meet with, either in the *Cloud* it self, or in its descent through the *Air*. Wherefore sometimes not only *Stones* are thus hurled down together with the *Lightning*, but also *Iron*, and other metals. AGRICOLA tells us, *lib.* 5. *de Ortu Subterraneorum*, that when it lightens in *Persia*, pieces of *Brass* fall down, which will not melt in the hottest *Furnaces*, but the moisture of them is turned into *Smoke*, and the rest of the Body into *Ashes*.

IV. *There is some reason to question the truth of these Thunder Bolts.*

But for all this, some think there is reason enough for us to look upon this Story of *Stones*, that are together with the *Lightning* discharged from the *Clouds*, as a meer fiction. Certain it is, that none of the *Ancients* ever made mention of it before AVICENNA: And it seems very strange, that if there be any such, none of them should ever be found in great Cities, such as *London* or *Paris*.

V. *How the Lightning can melt Gold in a Purse, and consume Wine in a Barrel, without hurting either the Purse or Barrel.*

Gold, *Copper* and *Silver* are by the *Lightning* melted in *Peoples Pockets*, without the least scorching of them: And the *Wine* that is kept in *Barrels* is consumed, without the least sign of hurt done to the *Vessels*. And MARCIA, a *Roman Princess*, being struck with *Lightning* when she was big with *Child*, had the *Birth* in her *Womb* killed without suffering the least hurt her self. *Pliny*, *lib.* 2. *Cap.* 51.

These strange effects must be ascribed to the various *matter* whereof the *Lightning* consists. For some consist of very *subtil Exhalations*, which are of the nature of *Volatil Salt*, or approach to that of *Aqua Fortis*. Now such as these do not touch loose and soft *Bodies*, but break and dissolve those that are *solid* and *compact*, and do resist their force. And therefore no wonder if such sort of *Lightning* do melt *Brass*, *Silver* and *Gold* without touching the *Purse* or *Bag* wherein they are: As we see that *Aqua-Fortis* doth not corrode *Wax*, tho' in a very short time it dissolves *Iron*, and other hard *metallick Bodies*. Whereof SENECA gives this Reason in Chap. 52. of his Natural Questions. *The Lightning*, saith he, *doth dissipate strong and solid Bodies with more vehemence, because they oppose a greater resistance to it; whereas it frequently passeth yielding substances, without the least hurt to them: It contends with Stones, Iron, and other very hard and solid Bodies, because it cannot make its way through them but by force; and therefore by extream violence opens it self a passage whereby it may get out. But on the other hand, spares loose and soft*

Bodies, tho' they seem the most proper for its Flames to fasten upon, because they let it pass without opposition.

VI. *How the Lightning consumes the Wine in Vessels without touching them.*

As to the *Lightning* consuming *Wine*, without touching the *Vessel*; the Reason is, because the most *subtil matter*, passing through the *Pores* of the *Vessel*, by its most swift and violent *agitation*, doth so diminish the *parts* of the *Wine*, and reduceth them to that extream littleness, that they can freely pass through the *pores* of the *Vessel*. By which means the *Wine* being wholly turned into *Vapours*, is in a short time thrust through the sides of the *Vessel*. Wherefore some, to prevent this disaster, lay a *Bar of Iron* with *Flints* and *Salt* upon the *Vessel*, which being hard *Bodies*, the *Lightning* exerts all its force upon them, and so the *Wine* or other *Liquor* in the *Vessel* escapes without hurt.

VII. *How Beer or Ale may be preserved from being spoiled by Lightning.*

Accordingly Mr. BOYLE assures us, that having *seal'd up a Glass Bottle Hermetically*, which he had fill'd with *Beer*; he found upon the opening, that the *Thunder* had not in the least changed the *Taste*, or any other of its *Qualities*; when at the same time that which was kept in *Vessels* was all turn'd sour.

The Reason is, because the *Exhalations* that constitute the *Lightning*, being diffused through the *Air*, do penetrate the *Vessels*, but not the *Glass*. He also tells us, that when *Smiths Coals* are kindled in *Wine-Cellars*, when it *Thunders* and *Lightens*, it preserves the *Beer* from turning sour; and this either because the *Fire* doth dispel and discuss those *Sulphureous Exhalations*, or because it dulls the force of them, by changing the *Figure*, *Magnitude* or *Texture* of the *particles* whereof the said *Steams* do consist.

VIII. *How a Woman may have the Birth in her Womb killed by Lightning, without any hurt to her self.*

As to the Story of MARCIA, who being struck with *Lightning*, brought forth a *dead Child*; this effect needs not to be attributed to the Power of *Lightning*, since probably it might be only the effect of her *Fear*; who being affrighted at the *Lightning*, miscarried thereupon. Or if we will suppose that she was struck with *Lightning*, the cause why it killed the *Infant* in her *Womb*, without hurting of her, might be, because the *Exhalations*, whereof that *Lightning* did consist, was of an *Oily* Nature, and *burning* only with a weak *Flame*, could only exert its force upon the weak and tender *Body* of the *Infant*, without touching the *Mothers Body*, which was more hard and solid. For so we find that *Lightning* sometimes consumes soft and tender *Bodies*, without hurting those that are more strong and solid; as the *Hair*, *Cloaths*, and the like, without any injury done to the *Flesh*: And that because the *particles* of the *Exhalation*, that form the *Lightning*, are like those of *Spirit* of *Wine*, which when set on *fire* do not touch a piece of *Linnen* so as to consume it, as being too weak and slender to separate the *particles* of the *Earthly Bodies* they meet with from others that are like to them, or from those of the 2*d. Element*.

IX. *How Animals are kill'd by Lightning.*

These *Exhalations* are also supposed the cause of the *death* of some *Animals*, found dead without the least sign of *Burning* or *Scorching*. For by the violence of these *Exhalations*, *Animals* may be so overpowered, as that thereby their *Muscles* design'd for *Respiration* may grow stiff and without *motion*; whereupon, no wonder if they be presently choaked. For these *Exhalations* may be so extreamly *subtil* and *pure*, as to be able readily to enter the *Body*, and hurt the inward parts of it, without the least sign of damage appearing upon the outward parts thereof.

X. *Whether the Bay-Tree be never struck with Lightning.*

Nothing is more commonly received amongst *Ancient Authors*, than that a *Bay-tree* is never toucht with *Lightning*, as being endued with a peculiar *virtue*, which resists and repels its *deleterious Spirits*. It was for this Reason that the Emperor TIBERIUS wore a Crown of *Bay-leaves*, when the face of the *Sky* seemed to threaten *Thunder* and *Lightning*. And COLUMELLA adviseth to cover the *Eggs* on which a *Hen* sits with twigs of the *Bay-tree*.

Some attribute this *virtue* of the *Bay-tree*, to the *figure* of it, which is very *round*, and hath a very smooth and close *Bark*: From whence they infer, that the *Exhalations* of the *Lightning* cannot fix upon it, but gliding from it, leave it untoucht. But this seems to be but a very weak Reason, forasmuch as *Marble Pillars*, which for *Roundness* and *Hardness* do far exceed the *Trunk* or *Body* of the *Bay-tree*, are frequently struck with *Lightning*, and damaged by it; as CARDAN assures us, *Subtil. lib.* 2. At *Florence* in the Great *Church* is to be seen a *Marble Pillar*, struck and hurt with the *Lightning*. For I suppose it to be a meer *Fable*, what is commonly reported of the *Bay-tree*; seeing that many *Authors* do assert, that *Bay-trees* have been sometimes *struck* with *Lightning*; as amongst others the *Conimbricenses*, and *Vicomercatus* in his Comentaries upon *Aristotles Treatise of Meteors*, by several instances proves the exemption of the *Bay-tree* from being hurt by *Lightning*, to be fabulous. The Reason probably why the *Ancients* attributed this *virtue* thereunto might be, because they abound with *Balsamick*, *Odoriferous* and *Spirituous Steams*, which may be of some force, in keeping off the efficacy of *poisonous Exhalations*. Tho indeed it be not at all probable, that the *Leaves* or *Stock* of the *Bay-tree* should be of such a *superlative virtue*, as to resist the force of *Lightning*, or to secure those that shelter themselves under its *Branches*, or wear the *Leaves* of it. And the same may be said of *Coral*, whatsoever PLINY saith to the contrary, *Lib. cap.* 55.

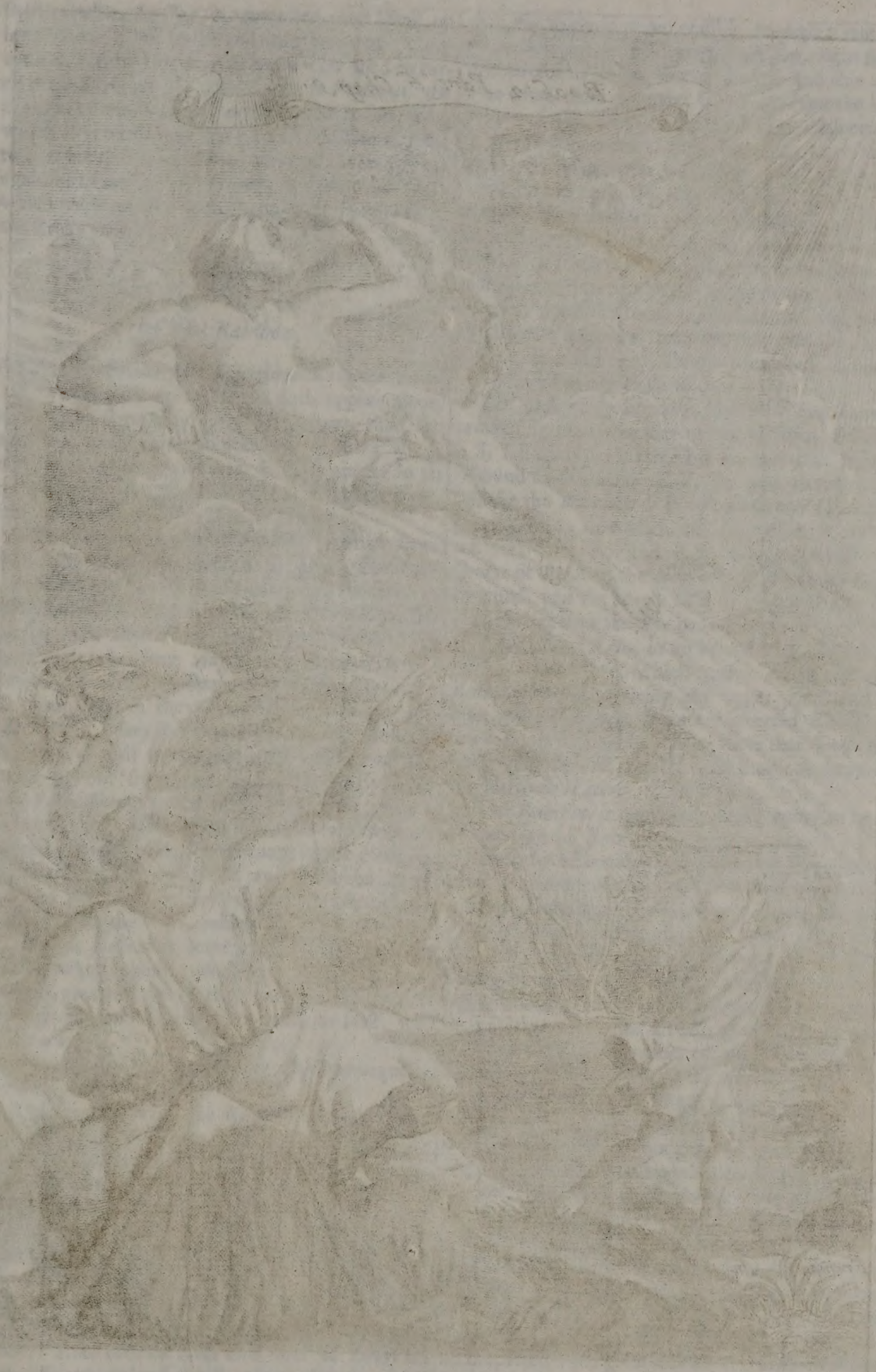
XI. *Whether a Sea Calf can never be hurt with Lightning.*

Authors assure us, that *Sea-Calves* are never struck with *Lightning*; and for this Reason the *Generals Tents* were used to be made of the *Skins* of this *Animal*. And SUETONIUS tells, that AUGUSTUS CÆSAR was so afraid of *Lightning*, that he always had some of them along with him in his *marches*.

Some attribute this *virtue* to the loose Texture of the *Skins* of these *Creatures*, because the *Lightning* pierceth through the *Pores* of them, without doing any hurt. But this Reason is not solid enough to prove such an extraordinary *virtue* to reside in these *Skins*. For how can that person be said to be exempt from the force of *Lightning*, who is covered with these *Skins*, if it can so easily pass through the open *Pores*, and loose Texture of them? Wherefore I am most apt to believe that this *virtue* was attributed to the Skin of *Sea-Calves*, because of the wonderful *Sympathy* they have with the *Sea*; for the *Hairs* of this *Animal* stare and

Bristle,

X.
Whether the Bay-Tree be ever struck with Lightning.



XI.
Whether a Sea Calf can never be burt with Lightning.

I.
The Primary or Original Rainbow is of more strong and lively Colours then the Secondary.

II.
Why the ends of a Rainbow appear sometimes at an unequal distance.

III.
Whether ever any inverted Rainbows appear.

Brittle, when the *Sea* is tempeſted, and lifted up into Waves; but lie flat and ſmooth whem a Calm returns. And therefore *Seamen* were uſed to carry theſe *Skins* along with them, to foreknow the changes of the *Weather*, and to provide for them; which afterwards may have given occaſion to ſome to imagine that theſe *Skins* were of ſovereign uſe againſt *Storms* and *Lightning*, and that the *Tents* which were covered with them, were exempt from the ſtroke thereof.

CHAP. IX.

Of the Rainbow.

I. *The Primary or Original Rainbow is of more ſtrong and lively Colours than the Secondary.*

THE *Primary* or *Original Rainbow*, and which for the moſt part doth appear alone, is of more ſtrong and ſprightly *Colours*, than the *Secundary*, which is ſeen above the former; whoſe *Colours* are not only weaker, but alſo appear in an oppoſite ſituation to thoſe of the *Primary Rainbow*.

The Reaſon hereof are the *Rays*, which from both theſe *Rainbows* arrive at the *Eye*. For they which proceed from the *Primary* and *Interior*, as in a *Glaſs Viol* arrive at our *Eye* after two *Refractions* and one *Reflexion*. And therefore the *Rays* meet under the ſame *Angle* they make with the common *Axis*, in the ſame point of the *Eye*, from the ſame *baſe* of the *Cone*. But the more outward or *Secondary Rainbow* is produced becauſe the *Beams* that fall upon the loweſt quarter of the drops, get out from them and reach the Eye after two *Refractions*, and as many *Reflexions*; which makes the *Red*, *Yellow* and *Green Colours* with all the reſt, that are very conſpicuous in the *Primary Rainbow*, to be very weak, and exhibited in an inverted poſture, in the outward or ſecundary. Foraſmuch as the *Rays*, which after two *Refractions* and one *Reflexion*, leave a leſſer *Angle* of *Elevation*, when another *Reflexion* is added, will make a greater; and on the contrary thoſe which made a greater, for the moſt part, at leaſt, will make a leſſer.

II. *Why the ends of a Rainbow appear ſometimes at an unequal diſtance.*

The two *ends* of a *Rainbow* appear unequally diſtant.

This happens when the *Rain* is bounded on that ſide where the *Spectator* ſtands on a *Plain* ſo inclined to the *Axis* of *Viſion*, as to make an *Acute Angle* towards the Left Hand, and an *Obtuſe* one towards the Right: For then it is neceſſary that the *Conical Figure* which determins the drops that we muſt ſee *coloured*, do meet with them in ſuch a manner, as that thoſe which are on the *Left*, be much nearer to the *Eye* of the *Spectator*, or to the *Axis* of the *Viſion*, than thoſe which are on the *Right Hand*: And becauſe theſe two ſorts of *Drops* do form the two ends of the *Rainbow*, therefore it is that they appear at an unequal diſtance: And if we have a mind to fix the *center* of this *Rainbow*, in a point equally diſtant from both the *ends* of it, then muſt they of neceſſity meet without the *Axis* of *Sight* or *Viſion*.

III. *Whether ever any inverted Rainbows do appear.*

Some tell us, that they have ſeen a *Rainbow*, with the ends of it turned upwards towards *Heaven*, as the ſame repreſented in the *Figure* by F F F.

Many ſuppoſe this to be no better than a *Dream* or *Imagination*: Yet for my part, I cannot ſee but that the thing may be poſſible enough; that is, when the *Rays* of the *Sun* by *Reflexion*, light upon the ſurface of ſome *Sea* or *Lake*; and this at a time when there is a great Calm, without the leaſt brieze of *Wind* to wrinkle the *Water*. Eſpecially if at the ſame time a *Cloud*, ſuch as is repreſented by G, do lie over the ſaid *Water*, and hinder the *Light* of the *Sun*, directly tending towards that part of *Heaven* where the *Rain* is, from ſuppreſſing or extinguiſhing that *Light*, which the *water* ſends back thither. True it is, that ſuch *Rainbows* as theſe are ſeen but very ſeldom: But it is not therefore preſently to be rejected as an *Imagination*, becauſe there are but few that ever ſaw ſuch a one. It is ſufficient, if ever it was ſeen, to make us enquire into the cauſe of it. Figure 25.

IV. *The Explication of an inverted Rainbow.*

Let us ſuppoſe therefore, that the *Sun Beams*, proceeding from that part of the *Heaven*, marked S S, fall upon the *water* D A E, and from thence rebound to the *Rain* C F, the *Eye* placed in B, will ſee the *Rainbow* F F, whoſe *Center* is in the *point* C. ſo as that when the *Line* C B. is drawn out further to A, and A S, paſſing through the *Center* of the *Sun*, the *Angles* S A D, and B A E, be equal, and the *Angle* C B F, of about 42 *Degrees*. Yet may the *Eye* be ſo placed, with reſpect to the *Sun* and *Rain*, as to behold only the lower part of the Circle, which makes up the whole *Rainbow*, without ſeeing the upper part; and ſo may make us to take it for an inverted *Rainbow*, tho it be then beheld, not by thoſe that look towards the *Heaven*, but by thoſe that look towards the *Earth* or *Water*.

V. *Why the Rainbow is a ſign of Rain.*

The *Rainbow* is commonly lookt upon to be a certain ſign of *Rain*.

Tho' this be commonly received by *Philoſophers* as an undoubted truth, yet cannot it be univerſally admitted, foraſmuch as experience ſhews us, that *Fair Weather* follows after the appearance of a *Rainbow*, as well as *Rainy Weather*. For tho' the *Cloud*, in which it is repreſented, be *Dewy* and big with *Rain*, yet may the *Temper* of the *Air* be ſuch at that time, that all the *water* that is contained in it may be evaporated, and by the heat of the *Sun*, vaniſh away into the *Air*: Which being ſo, it will not ſeem ſtrange to any, if no *Rain* ſhould follow upon it, but *Fair Weather*. Whence it is Evident, that it is not generally true what *Ariſtotle* aſſerts, that a *Rainbow* that begins preſently after *Noon*, doth always bring copious *Showers*; but that which appears about *Sun-ſet*, doth only threaten ſome ſmall *ſprinklings*, rather than any great *Rain*. Seeing that theſe *ſigns* do often fail, and that *Rainbows* appearing in the Afternoon, are ſometimes followed by *Fair Weather*; and on the contrary, thoſe that are ſeen about *Sun-ſet* are accompanied with great *Showers*. And therefore I am more inclined to be of *Pliny*'s opinion in this caſe, who ſaith, that frequent *Rainbows* do not with any certainty portend either *Rain* or *Fair Weather*.

VI. *What is the Reaſon why ſometimes three Rainbows have been ſeen at one time.*

Sometimes three *Rainbows* have been ſeen at a time, ſo as that the third ſupervening, hath encompaſt the two common ones, but withall hath appeared *paler*, and leſs ſtrong and refulgent than the other, and at the ſame diſtance from the 2*d*. as the 2*d*. was from the 1*ſt*.

The appearance of this 3*d*. *Rainbow*, is cauſed by the *Hail* that is mingled with the *Dewy* or *Rainy*

Rainy Cloud. For seeing that the *Hailstones* are round and transparent, and that a greater *Refraction* is produced in them, than there is in the *Air*, the outward *Rainbow* must needs be much greater, and so appear above, and surrounding the other. And the inmost, which for the same reason must have been much less than the middlemost of *Rain*, may by reason of the great Brightness of the former, have altogether lost its appearance, so as that both of them may have been taken for one; but yet for such a one, the *Colours* whereof were otherwise placed than in the Ordinary or Common *Rainbow*. Wherefore the 3*d*. *Rainbow* agrees with the *Primary*, because it is formed by *Rays* falling on the upper part of the *Drops*, and therefore do both of them represent their *Colours* in the same order, save only that in the 2*d*. the *Colour* does by degrees grow weaker than in the 1*st*. and in the 3*d*. than in the 2*d*.

VII. *Why the Rainbow affords a Sweet Odor.*

The *Ancients* have observed, that a sweet *Odor* is perceived in all places whither the *Rainbow* inclines, or which it hovers over.

The Reason is, because the soft and pleasant *Dew* of the *Rainbow* is proper to draw forth the perfume of *Odorous Bodies*. For we find that moderate *Showers* have the same effect, tho' not in so high a degree; for nothing affords to the *Ground*, or fills the whole *Air* with a sweeter fragrancy, than the *Dewy Rain* of the *Rainbow*, wheresoever it falls. So that for ought we know, there may be a fragrancy in the *water* it self that composeth the *Dewy Cloud*; seeing that a *Rainbow* is nothing else than drops of *water* clustered together, which cannot come down in *Rain*, but from that part of the *Air* which is near the *Earth*, and therefore more proper to imbibe and retain the fragrancy of the *Herbs* and *Flowers*, like a distilled *water*. For *Rain* or any other *Dew* that falls from a great height cannot retain the sweetness which was dissipated whilst the *Exhalation* was mounting so high. And therefore PLINY observes, *lib.* 12. *cap.* 24. *That whatsoever Plant the Rainbow hangs over, it doth impart to the same a sweetness like to that of the Rose of* Jerusalem; *but to that Plant a most inexpressible fragrancy.*

VIII. *The Rainbow doth not appear the same to all.*

The *Rainbow* appears not the same to all, but every one sees his particular *Bow*: So that as many *Bows* are represented in the *Dewy Cloud*, as there be *Eyes* directed towards it.

The Reason of this multiplicity is manifest; because the *Rays* which come to the *Eyes* of one person, do not reach the *Eyes* of another. For tho' every drop do reflect one of the *Suns Beams*, yet the whole *Cloud* only sets forth the *coloured* representation of the *Rainbow*, whilst it is so posited, that it makes its *Reflexion* at a certain *Angle*: Wherefore as any approacheth nearer to the *Rainbow*, or withdraws further from it, he doth not see the self same *Bow*, but still a different one, according as the said *Angle* encreaseth by his approach to, or decreaseth by his withdrawing from it.

IX. *The Moon sometimes forms a Rainbow.*

The *Moon* sometimes affords the appearance of a *Rainbow*, which ARISTOTLE tells us, happens only one day of the *Month*, *viz.* that of the *Full Moon*.

It cannot be questioned, but that the *Lunar Beams* may fall upon a *Cloud*, and exert its action in such a manner upon every one of the drops of it, as that by *reflexion* to our *Eye*, they may represent a *Rainbow*, which is weaker indeed than that which is formed by the *Sun*, nor deckt with so great a variety of *Colours*. BOMBACHIUS assures us that he saw such a one at *Oxford* in the Month of *June* 1606. But whereas ARISTOTLE tells us, that it is only to be seen at a certain time, that I suppose to be without ground of Truth, since there are *Authors* who assure us that they have seen the same twice in the space of two years, and that on several days, and that not at the *Full Moon*, but at the *Quarters*. And SCALIGER in his 8*th*. *Exercitation*, speaks of it as a common thing in the Isle of St. *Thomas*; where he saith, *If Rain hath preceeded, there is always a Rainbow formed by the Moon, the Colour whereof represents, as it were, a whitish Mist.* I my self once beheld a *coloured Lunar Rainbow* in *England*, near *Hampton Court*, about the middle of *October*, when the *Moon* was at her *Quarter*; and had Sir *Charles Waldegrave* for a witness of this unusual sight, and who was not a little surprized to see such a one in the Night. For it appeared so plain, and with such distinct Colours, that it was very like a *Solar Rainbow*, save only that the representation of it was not so strong and refulgent.

X. *How Circles come to be formed about Candles.*

It happens sometimes that we see *circles* of the *colour* of the *Rainbow* about *Lamps* and *Candles*. Such as are in the *Figure* represented by the *Letters* AB, CD, more especially after that any one hath for some time kept one of his Eyes shut.

There are some who attribute this effect to the *Air* that compasseth the *Candle*, which by its thickness reflects the *Rays*, and transverts them. But that this is a mistake, is most evident from hence, because this *Circle* is not seen by all, which must be in case it were an effect of the thickness of the *Air*. We shall therefore easily apprehend the manner of the forming of it, by discovering the cause of the *Transverse* or *Cross Rays*, which sometimes appear there. Which I say may then happen, when there are one or two little wrinckles in any one of the surfaces of the *Coats* or *Membrans* of the *Eye* EMP, which because of the *Figure* of the *Eye* FO, SMN, wee'l suppose to be circular, and have their *Center* in the *Line* EO; as frequently there be there others also extended according to the Right *Lines*, which discussate or intersect one another in this *Line* EO, and make us see some great *Rays* scattered this way and that way, about the *burning Candles*; and this notwithstanding, any *Opake Body* might intervene, either betwixt E and P, or elsewhere on the side, as long as it doth but circularly diffuse it self. Or lastly, The same may happen, because the *Humours* or *Membrans* of the *Eye* have in some sort or other changed their Temperament or *Figure*. For it is very common with those who have sore or weak *Eyes*, to see these *Circles*, neither do they appear to all persons alike. Figure 26.

XI. *Why the outward Rims of these Circles are commonly Red.*

Particularly we are here to take notice, that their outward *Rims*, represented by A and C, are for the most part *Red*, quite contrary to those which we sometimes see represented about the *Stars*. The reason whereof will evidently appear if we consider that in the production of those *Colours* whereof they consist, the *Crystallin Humour* PNM, per-

performs the *office* of a *Priſme*, and the *Retina* F G F, the part of the *Linnen-cloath* that receives the *Beams* paſſing through the *Priſme*. But ſome may queſtion, foraſmuch as the *Cryſtalline Humour* is able to perform this, why it doth not do as much to all other Objects, by repreſenting the *colours* of the *Rainbow* about them? Wherefore we muſt take notice, that many *Rays*, from every ſingle point of the Objects, do arrive at the ſeveral points of the *Retina*; and becauſe ſome of them paſs through the part N, of the *Cryſtalline Humour*, and other of them through the part S, therefore alſo they act in a contrary manner upon them, and deſtroy one another, at leaſt as to the production of *Colours*: But that here all thoſe which come to the part of the *Retina* F G F, do only paſs through the part N, of the *Cryſtalline Humour*, and therefore that the *Rotation* which they acquire there may be felt. All which perfectly agree with thoſe things which we have delivered in our *Inſtitutions of Philoſophy* concerning *Colours*.

CHAP. X.

Of Fires kindled in the Air.

1. *Why thoſe Meteors called Wills with the Wiſp, do lead men towards Pools and Rivers.*

WILLS *with the Wiſp* or *Wandring Lights*, do frequently lead perſons to *Lakes* and *Boggy Places*; and make them fall into *Precipices*, or loſe their way.

This effect may be explained from what we have ſaid before concerning *Winds*. For ſeeing that more *Vapours* are raiſed in the *Night* from the *Earth*, than from the *Water*, this is the cauſe why theſe *Wandring Lights* or *Fires*, that follow the motion of the *Air*, do take their courſe towards *Waters* and *Pools*, becauſe thereabouts the *Air* is more cool, by reaſon of a leſſer agitation, and conſequently becomes thicker and more condenſate, than that which lies cloſe upon the *Earth*; ſo that theſe *Wandring Fires*, being in a manner born up by the *Wings* of the *Air*, and complying with the motion of the ſame, are carried thither from the neighbouring *grounds*.

II. *Why theſe wandring Fires follow thoſe that flee from them, and flee from thoſe that follow them*

Nothing is more commonly aſſerted by *Philoſophers*, than that *Wills with the Wiſp* do flee from thoſe that purſue them, and follow thoſe that flee from them. And this they prove from many Examples, as may be ſeen in FROMUNDUS.

The cauſe of this is imputed to the *Air*, which being *light* and *fluid*, and ſhaken by the agitation of the perſon that walks along, doth either drive them forwards, or drags them along after him, when he runs from them. For if this *Meteor* ſtand before him that *walks*, by his driving the *Air* before him, it is driven forwards, and ſo flees from him that follows it: But if it be behind him that walks, foraſmuch as the following *Air* accompanies him, it alſo follows him fleeing from it.

III. *Why theſe Fires are much ſeen about Churchyards and Common-ſewers.*

Wills with the Wiſp are commonly ſeen about *Churchyards*, *Common-ſewers*, *Fire-vomiting Mountains*, and other places where great ſlaughter of *Men* or *Beaſts* have been made.

The Reaſon is, becauſe theſe *Wandring Fires* conſiſt of *fat* and *viſcous ſteams*, which having no ſuch quantity of *ſubtil particles* mixed with them, by means whereof they might be carried upwards, do fluctuate in the lower part of the *Air*, and are forced, becauſe of the cleaving tenacity of their parts, and the *Earthly Matter* that is mixed with them, to tend downwards by their *weight*, rather than mount upwards; and move eſpecially about *Church-yards*, *Layſtalls* and ſuch like places, as abounding with a greater quantity of *Fat* and *Oily Particles*.

IV. *What is the cauſe of thoſe Flames that ſometimes appear about, or upon the Hair of Children.*

We read in the Writings of the *Ancients*, of *Fires* or *Flames* that have been ſeen hanging upon the *Hair* of *Children*, and that without hurting or ſcorching their *Hair*. According as VIRGIL tells us, that this hapned to *Aſcanius* the Son of *Æneas*, *Lib.* 2. *Æneidos*.

Lo from Julus Crown a flaming Light
Was ſeen to riſe, and harmleſs Fire did ſpread,
With a ſoft touch, and round his Temples fed.

The cauſe of theſe *flames* is, when a *ſubtil* and *penetrating Exhalation* (ſuch as participates of the nature of *Salt*) doth enter the *Pores* of another that is *Fat* and *Sulphureous*. This being of it ſelf ſufficient to kindle ſome thin and *ſubtil flames*, as well on high, as in the lower parts of the *Air*. For certain it is, that not only a violent agitation, but the *mixture* only of different *Bodies*, is ſufficient to produce *Fire*. As we ſee in *Quick-lime* that is ſprinkled with *Water*; and innumerable other *Examples* which daily occur to *Chymiſts*.

V. *Theſe Flames may alſo proceed from a Commotion of the Spirits.*

Theſe *Lambent Flames* may alſo be cauſed from a commotion of the *Spirits*, that ruſh out from the *Body*, and being intangled together, repreſent the appearance of *Fire*: Thus *Hiſtorians* tell us, that ALEXANDER *the Great*, in the heat of *Battle*, darted *ſparks* from his *Body*; and that ſomething like this hapned to the *fierce Horſe* of the *Emperour* TIBERIUS, from whoſe Head a *flame* was ſeen to break forth. For *Alexander* being of a *fiery complexion*, and addicted to the drinking of *Wine*, it cannot ſeem ſtrange that he ſent through his *Pores* ſuch *Spirits* as were proper to kindle *flames*: No more than that from TIBERIUS his *Horſe*, when he had heated himſelf with running, a fat and viſcous *ſweat* did break forth, which kindled into a *flame*, but ſuch a one as was harmleſs, and without any burning or ſcorching quality. In like manner as the *flame* of *Spirit* of *Wine*, which hath ſome *aqueous particles* mixt with it, doth not burn the *Linnen Cloth* that is *moiſtned* with them.

VI. *Why ſparks of Fire proceed from a Cats Back when rub'd.*

And it is for the ſame reaſon, that when we rub a *Cats back* contrary to the *hair*, eſpecially in the *Winter*, ſparks of *fire* dart forth from it, becauſe *Cats* in the *Winter* are fatter than in the *Summer*, and therefore are able to furniſh a greater quantity of a *fat clammy humour*, proper for the exciting of theſe *Sparks*. But becauſe in the *Summer* theſe *ſteams* do more eaſily break forth into the *Air*, and are diſperſt there, it cannot ſeem ſtrange, that when the proper *matter* for the *generating* of theſe *Sparks* fail, they ſhould ceaſe alſo, and not then appear upon the rubbing of the *Cats back*.

VII. *What Falling Stars are.*

In clear *Nights*, *Stars* ſeem to ſhoot or fall from the *Sky*.

The cauſe is, when after a very hot and dry *ſeaſon*, the ſpace which is between two Clouds, is filled with copious *Exhalations*, that are very *ſubtil*, and proper to take *fire*: For if theſe be ſo light and looſe of *Texture*, that one of them falling from on high, doth not produce any noiſe of *Thunder*, nor cauſe any *Tempeſt* in the *Air*, yet the *Exhalations* lying between the ſaid Clouds, may be ſo twiſted together, as to exhibit the appearance of ſome leſſer *flames*, which are commonly called *falling* or *ſhooting Stars*. Becauſe by inflammation the combuſtible *particles*, which were the cauſe of their aſcent, were thereby conſumed and vaniſh; and therefore the *Star*, which at the beginning of its deflagration, complied with the motion of the *Air* that carried it, was called a *running* or *ſhooting Star*; afterwards, when its more *ſubtil parts* were *burnt* away, falls down, becauſe the weight of the *Earthy* and *viſcous matter*, doth exceed the heavineſs of the *Air* that lies under it; and then is called a *falling Star*. And therefore theſe *Meteors* receive a different denomination from the various ſpecification of the kindled *Exhalation*. For if an *Exhalation* that lies at length, becomes kindled, it is called a *Beam*; if at the bottom it be ſomewhat broader, 'tis called a *Pyramid*; if it be broad about the midſt, and ſmall at both ends, 'tis called a *flying Dragon*, &c.

VIII. *Why thoſe Fires which are formed near the Earth do continue for ſome time, whereas thoſe that are produced high in the Air are of no long continuance*

Fires generated near the *Earth*, continue for ſome time; whereas thoſe formed in the uppermoſt part of the *Air* do preſently vaniſh.

The Reaſon is, becauſe a *flame* doth cleave more ſtrongly or weakly to any matter, according as the ſaid matter is more or leſs cloſe and compact. Now foraſmuch as theſe *Meteors* which are formed in the upper *Region* of the *Air*, do conſiſt of a very *looſe* and *thin matter*, it is plain that their *flame* cannot continue long. For indeed if this *matter* were *thick* and *cloſe*, it would by its own *weight* ſink towards the *Earth*, and leave its former *ſtation*. And therefore ARISTOTLE in the *firſt Book of his Meteors*, ſuppoſeth them to be like that *flame*, which runs along the *ſmoak* or *ſteam* of a newly *put out Candle*, which is apt to be kindled again by another that ſtands near it.

IX. *What is the cauſe of the Appearance of Armies in the Skies*

In the *Sky* is ſometimes repreſented the appearance of *Armies*, and *Soldiers fighting*. Such a Repreſentation as this is reported to have been ſeen in *Sileſia* in 1545. A *Bear* appeared in the *Eaſt* at the head of an *Army*, and was met by a *Lion*, who led an *Army* from the *Weſt*: Between both theſe *Armies* there appeared alſo a moſt bright *Star*; and preſently after they engaged, ſo that the *blood* ſeemed to drop from the *Bodies* of thoſe who were wounded, and many as it were fell down dead. As theſe *Armies* were *fighting*, an *Eagle* coming from an high *Rock*, hovered over the *Lions Army*. And after the Battle was ended, the *Lion* ſhone bright in the midſt of his Forces; but there was no appearance of the *Bear*. The place where both the *Armies* ſtood was all covered with *dead bodies*, and by them ſome old Men, venerable for their *Gray Hairs*. Afterwards the *Lion* led off his *Army* towards the *Weſt*; who after he was got ſome way from the place of the Battle, a perſon riding upon a *white Horſe*, adorn'd with *Trappings*, returned from the *Army* to the place where the Battle was fought, and ſet a young Man armed *Cap-a-pee* upon that *Horſe*, and having accompanied him ſome part of the way towards the *Eaſt*, vaniſhed together with all the other Apparitions.

X. *The Common-People very apt to believe ſuch Stories as theſe.*

I am very well aware how greedily ſuch *ſtories* as theſe are embraced by the *common People*, and how ready they are to lay hold of any thing, which they imagin may diſcover to them the knowledge of future *Events*. And therefore if they do but ſee two Clouds ſtanding over againſt one another, and enterchanging ſome *Refractions* or *Reflexions*, this is ſufficient for them to apprehend two *Armies fighting*, that the more bright *portions* of them are *Soldiers in whole* and *bright Armour*, that they hear the claſhing of *Arms*, *diſcharging of Muſquets*, &c. I my ſelf once in a clear night in *Flanders* ſaw ſome *Vapours* ſcatter'd in the *Air*, in an unuſual manner, and giving ſome light from them, which did ſo terrifie the *Inhabitants*, that the next day all the news was that they had ſeen *Armies* in the *Air*, heard the ratling of *Pikes*, the diſcharging of *Muſquets*, the claſhing of *Swords* and the ſound of *Trumpets*.

XI. *What may be the cauſe of an Army appearing in the Air.*

But becauſe it may happen that ſuch appearances as theſe may really be ſeen in the *Air*, I will here add two probable cauſes whence the ſame may proceed. The Firſt is, That there may be in the *Air* various Clouds of that ſmallneſs, as that every one may exhibit the appearance of a *Soldier*, and ruſhing one upon another, may contain a ſufficient quantity of *Exhalations*, to produce ſome ſmall *flaſhes* of *Lightning*, and cauſe ſome *ſounds* or *noiſes*; and ſo repreſent the *fighting* of *Souldiers*. The other is, when all theſe ſmall Clouds do ſhine, and reverberate that *light* which the *Lightning* of ſome great *Tempeſt* happning at ſo great a diſtance, as that they cannot be perceived there from the *Earth*, do reflect upon them.

CHAP. XI.

Of Circles about the Sun, or Moon, and of Mock Suns.

I. *Why no Circles appear about the Sun or Moon but in fair weather.*

Circles about the *Sun* or *Moon*, never appear but in fair *weather*, and in this are diſtinguiſhed from the *Rainbow*, which ſeldom appears but in rainy *weather*, tho' perhaps it may not rain in that place where the *Spectator* is.

The Reaſon of this difference is, the variety of their compoſition. Becauſe theſe *Circles* are not formed by the *Refraction* of *Rays* from *drops* of *water*, as the *Rainbow* is generated, but by that *Refraction* which proceeds from the little *Stars* or *Spires* of tranſparent *Ice*; and tho' theſe *Stars* do never fall from the *Sky* but in *cold weather*, and the froſty *Months* of the *Year*; yet reaſon convinceth us, that they are produced at any other time alſo: Yea, and foraſmuch as they ſtand in need of warmth, which of *white* as they are at firſt, may make them tranſparent, it ſeems very probable that the *Summer* time may be the moſt proper for the forming of them.

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II. *What is the cause of double Circles.*

Sometimes double *Circles* have been seen in the *Sky*, ſo placed as that one of them did ſeem to encompaſs the other, and to appear concentrical with it.

This is cauſed when two Ranks of ſuch *particles* of *Ice* are placed together, ſo as not to exclude the *Rays* of the *Sun*: For then thoſe *Rays* which paſs through both theſe Ranks at the end of theſe little *Stars*, being almoſt bent as much again as thoſe others that paſs through one Rank only, will produce another coloured *Circle*, much greater in compaſs than the former, but leſs bright. So as to make two *Circles* appear, whereof the one doth encompaſs the other, the more outward whereof is of leſs *lively colours* than the inward.

III. *Why theſe Circles are never ſeen about the Sun or Moon at their Riſing or Setting.*

Circles are not uſually ſeen about the *Sun* or *Moon*, whilſt they are near to the *Horizon*, that is, when they do either *riſe* or *ſet*.

The Reaſon is, becauſe then the *rays* of theſe *Luminaries* do fall ſo obliquely upon the *particles* of *Ice*, that by reaſon thereof they cannot penetrate them: And conſequently there can be none of thoſe *Refactions* which are the formers of theſe *Circles*.

IV. *What is the cauſe of many Suns appearing in one Circle.*

Many *Mock Suns* ſometimes appear in the ſame *Circle*. Thus it is recorded, that in the year 1625. the King of *Poland* ſaw no leſs than ſix of them; and five appeared to the People of *Rome* in the year 1629. and that for four hours together.

Theſe *Parhelia* or *Mock Suns* are formed in a Cloud, conſiſting of a continuous piece of *Ice*, the ſurface whereof being very even and ſmooth, is illuſtrated by the *Sun* elevated towards its *Meridian Height*, and reflects the *rays* it hath receiv'd againſt the *Snow* of the Cloud that doth compaſs it. For then the *Snow* appears to thoſe who behold it from the *Earth*, like a great *white Circle*, wherein one *Circle* is ſeen by means of the *rays* which flow from the Sun *directly*; and the two following from their *refraction*, and the reſt by the *reflexion* of them.

V. *How it comes to paſs that ſome ſee more Suns in the ſame Circle than others.*

Many *Suns* appearing in the *Heavens*, are not ſeen alike by all; for ſome *Spectators* ſee more *Suns* in one and the ſame *Circle*, others leſs.

The Reaſon is, becauſe the *rays* that proceed from theſe *Suns*, are not after the ſame manner conveyed to every *Spectator*; foraſmuch as ſome may be ſo placed, as to ſee no more than two of them; and others again ſo as that they can ſee three, four or more of them, according as the place is from whence they direct their *Eyes* towards them. For the *rays* do not affect the *Eyes* of all *Spectators* alike; neither do thoſe which fall upon the *Eyes* of one *Spectator*, reach thoſe of another: Seeing it is certain, that he who moves from one place to another, doth ſee ſtill other and other *Stars*; and as upon ſhifting places, we ſee other *Circles* about the *Sun* or *Moon*, ſo likewiſe different *Mock Suns*. Moreover, ſeeing it is certain, that either the *Earth* or *Sun* muſt move, it cannot be but that when the *Sun* ſhifts its ſtation, or when the *Spectator* is whirl'd about together with the *Earth*, the *Angle* of Sight muſt needs be changed, and thoſe *Stars* which he ſaw before, will have loſt the *Latitude* under which they appeared to him at firſt. Whence it is that every *Spectator* ſees ſuch and ſuch *Mock Suns*, according to the difference of the place, where he is at this or other times.

Mock Suns commonly have a long *Tail*, of a very bright and refulgent *white Colour*.

VI. *Why Mock Suns have commonly long Tails.*

The cauſe is, either the *reflexions* which are made on the *ſurfaces* of the little *Icy Bodies* which are turned towards the *Sun*; or thoſe contrary *refractions* which the *rays* ſuffer in paſſing through them: Or, it may be, from both theſe cauſes together; as ſeems to be confirmed by Experience in thoſe ſmall *drops* of *Rain* which are about a great Cloud, that hides the *Sun* from us: For we ſee that theſe little *drops* of *Rain*, or *particles* of *Snow* half melted, receive a *bright whiteneſs*, not only by the *rays* reflected from their *ſurface*, but alſo from thoſe which by penetrating them, do ſuffer contrary *refractions*, that is to ſay, which deſtry one another.

VII. *What is the cauſe of the Suns being ſometimes ſeen at night.*

Hiſtorians aſſure us, that the *Sun* hath been ſometimes ſeen at *Night*, and appeared above our *Horizon*, when yet it was certainly far under it.

The Reaſon of this ſtrange appearance was this, becauſe there were Clouds made up of little *Icy Stars*, placed in ſo high a Region of the *Air*, as that the *rays* of the *Sun*, then below the *Horizon*, could reach them. For if we do well conſider thoſe *reflexions* and *refractions* which two or three little Clouds, ſituate in divers places, and receiving light one from another, can produce, we ſhall eaſily apprehend how they may in the night-time exhibit a very ſtrange and unwonted light, and cauſe, as it were, the *Sun* to appear above our *Horizon*, at that time when it is indeed under it; and the ſhadows on our *Sundials* to be nearer or farther off than they ought to be, and conſequently point at another hour than it is indeed.

VIII. *Whether Mock Suns be the foreboding ſigns of great Calamities.*

It is obſerved that the appearance of *Mock Suns* have been the fore-running *ſigns* of the *revolution* of *Kingdoms*, the *death* and *murder* of *Princes*. Hence it is that almoſt all *Meteorologiſts* aſſert, that thoſe ſix *Mock Suns* which were ſeen by the King of *Poland*, did prognoſticate the taking of *Francis* I. of *France* at the Battle of *Pavia*: And that thoſe *Mock Suns* which appeared in the year 1157. did foretell the great diſſention that hapned ſoon after amongſt the *Electors*, in their chooſing of a *King* of the *Romans*.

It cannot be denied but that after the appearance of *Mock Suns*, ſome ſtrange and uncommon effects do frequently happen: But who will ſay that they proceeded from this *Meteor*, and not rather by meer accident, and without any the leaſt reference to the ſame? Or ſhall we ſay that there is ſuch a cloſe Union and near Relation between the *Heavenly Bodies*, and the Affairs of *Mankind*, that when ever ſuch and ſuch *Meteors* appear, ſuch effects muſt follow in the other? Sure it is that *Mock Suns* would appear, tho' no ſuch effects were to follow; and ſtrange things would happen in the *World*, tho' no ſigns in *Heaven* ſhould uſher them in. Or ſhall we ſuppoſe, that Nature will ſurceaſe its activity, and *natural cauſes* not unite in order to the producing of their *effects*; except *Kings* wage War, *People* diſpatch their *Princes*, and *overturnings*, *devaſtations* and *ſlaughters* happen to *Governments*? How many *Kings* leave this *world*, how many *Countries* are waſted, when yet no *Mock Suns* have appeared to give any warning of theſe *Accidents*? If therefore after the

appear-

appearing of *Mock Suns* any great *Slaughters* or *Revolutions* chance to happen, this cannot seem strange, if we consider the Temper of Men, who are never content with their own condition, but are always reaching after that which is anothers. Besides, why should *Mock Suns* portend such *events* any more than many other natural *Phænomena*? And is it not meerly accidental, that they appear this time rather than another? What an unaccountable *Pride* and *Vanity* is it in Man, to imagin himself to be of that value and consideration, that for his sake *Prodigies* must be formed in *Heaven*, that *Comets* must appear when ever the humour takes him to wage *War*; and that *Suns* must be multiplied, when the great *Men* of the *Earth* are at variance together, or some other *Emblems* must be represented in the *Air*, when ever they are *Sick*, or drawing near to their last end! Pray let us never have so high an opinion and conceit of our selves, as to imagine that all these *appearances* are formed in the *Heavens* on purpose to warn us of future *events*. But let us rather consider that all these are *natural effects*, which cannot but be formed and appear when ever their causes do concur and meet together. That their appearing but very seldom, cannot in the least conduce to their efficacy, or to render them more considerable: For their Rarity or Infrequence doth no more prove them to be *Prodigies*, than it is an argument that a *Lion* is a miracle in Nature, because we very seldom see any, or for that they are not so common as other *Beasts* that are frequent amongst us.

The Seventh Part OF THE HISTORY OF NATURE. OF PLANTS.

CHAP. I.

Of the Parts of Plants.

I. *Why every Plant hath a Root.*

EVERY *Plant* hath a *Root*, neither is there any supposed to want this necessary part, except only the *Indian Plant* called *Malabathrum*, whose *Leaves* grow spreading upon the *Water* as if they had not any *Root* at all.

The necessity of this part is obvious from the nature of *Plants*, to the conservation whereof it is absolutely necessary, that some part of it cleave and stick fast in the *Earth*. For a *Plant* with its *Root*, as with a *hand* or *claw* lays hold on the *Earth*, and by its spreading *Fibres* takes possession of a part of it. To this may be added that *Vegetables* make use of their *Roots* for a *Mouth*, wherewith they suck in their *Nourishment* out of the *Earth*. For seeing that the life of *Vegetables* consists in *perpetual motion*, their inward *moisture* would be soon consumed, except a new supply were continually conveyed to them from the *Root*. Neither indeed, if the matter be narrowly examined, will the *Indian Leaf* called *Malabathrum*, nor the *Herb* common amongst us, called *Duck-weed* be found altogether without *Roots*, whatsoever *Antient Writers* may have left recorded concerning them: For when we do more narrowly behold these *Plants*, we shall find them to have a small stalk which reaches to the bottom of the place whence they are taken. And therefore when we dissect a *Root*, we find parts in it that are as substantially the same with the *little Root* of the *Seed*, as the *Members* of a *Man* are the same with the *Organs* of a *Birth* in the *Womb*. So that the *Root* of a *Plant* seems to be nothing else but a spreading of the *Stalk* or *Stem* into several little *Branches* and *Capillaments*. Neither doth it contradict what we have here asserted, that *Misselto Dodder* of *Thyme*, and others of the same *nature*, have no *Roots* that stick in the ground; for tho' they have none, yet the *Plants* on which they grow, and to which they are fastned, have theirs fixed in the *Earth*.

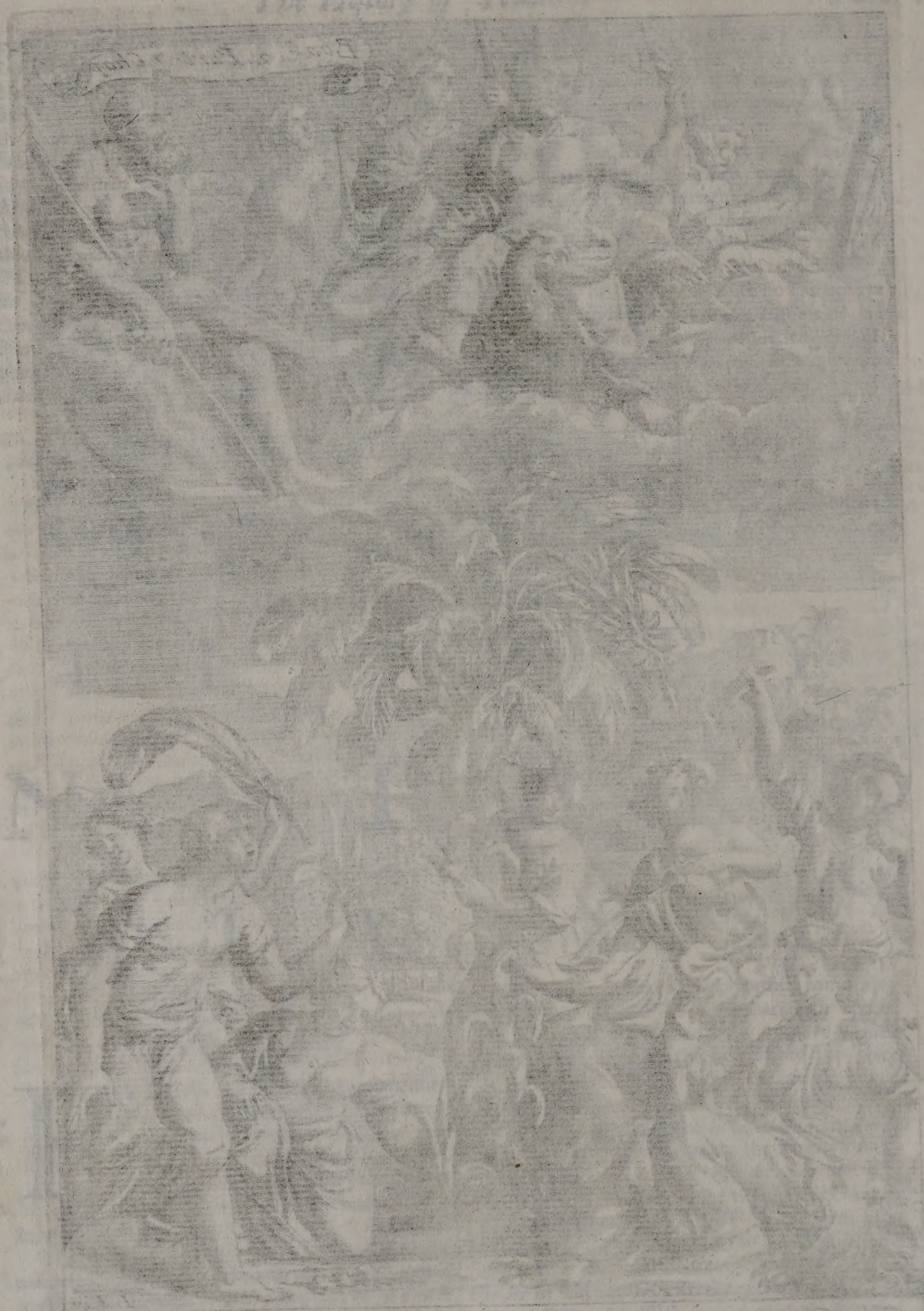
II. *Why straight timber'd Trees are not so lasting as others.*

Hence it was that DEMOCRITUS was of opinion, that straight *Trees* were shorter liv'd than crooked ones, forasmuch as their *Roots* were weaker, and for that the straightness of their *Passages* or *Vessels* were not so proper to retain their *Aliment*. Tho' we find the contrary in the *Palm*, *Fir* and *Cypress Trees*, which tho' they be very straight, yet are long lasting, and that because of their thick and long *Roots* by which they suck in their *Aliment*.

The

To George London of their Majesties Royall
Garden in S.t James-Parke Gent: Deputy Superintendant
and Master Gardiner of their Majesties
Gardens and Plan- tations in England.

This Plate is humbly Dedicated by Richard Blome



Chap.

III. *Why the Roots of some Plants are round, others long and slender.*

IV. *The Compression of the Earth makes the Roots to grow the faster.*

V. *Why the Stalks of some Herbs are hollow.*

VI. *Why the Bodies of Trees are round.*

III. *Why the Roots of some Plants are round, others long and slender.*

The *Roots* of some *Plants* grow more thin and slender, as they enter deeper into the ground, and end in a Cone or slender Point, as the *Roots* of *Trees*. But the *Roots* of other *Vegetables* swell into a round *Root*, as *Turneps*, *Tulips*, *Onions*, &c.

The Reason why the *Roots* of *Trees*, and most other *Vegetables* are slender towards the ends, is because the *Juice* passing through them, is carried upwards, and abides longer in the upper part of the *Plants*; for tho' the *heat*, by the *virtue* whereof *Nutrition* is performed, doth extend it self into all parts, and be carried upwards and downwards, yet it is certain, that it is always more strongly conveyed to the upper parts, than towards the lower; and therefore seeing that the upper part of *Trees* doth receive more *nourishment*, and is longer *nourished*, it is no wonder if be also bigger and larger, and that the *Roots* end in a point. But the *Roots* of *Turneps*, &c. are *Round*, because their *nourishment* is received into the first joint of them, which consisting of several entangled *parts*, and being endued with narrow *pores*, the *nourishment* cannot freely pass or be strained through them, and therefore it is necessary that the said *matter* be diffused sideways, and that the *Fibres* which are big and swell'd with *juice*, spread and enlarge themselves.

IV. *The Compression of the Earth makes the Roots to grow the faster.*

If an *Herb* be cut up by the *Roots*, and put again into the *Earth*, and the same be strongly beaten down, and this about the beginning of *Winter*, the *Roots* will be found extreamly encreased the following *Summer*.

The Reason is, because *moisture* having by this means been hindred from entring into the inward parts of the *Plant*, doth the longer continue in the *Root*, and dilate the same. And therefore it is common with *Gardners* after they have sowed *Onions* and *Turneps*, to press down the loose *Earth* round about them with *Rowlers* or the like.

V. *Why the Stalks of some Herbs are hollow.*

Some *Plants* have hollow *Stalks*, as all sorts of *Reeds*, and the *Straw* of *Corn*, but with *joints*.

The Reason is, because the *Fibres* which serve to convey the *nourishment*, are not derived from the *Pith* of the *Plant*, but from the sides of the *budding Knot*; which because they withdraw from the middle, and observe a certain distance, do leave a certain space there, and produce a Cavity. Hence it is that in *Onions* the *Pipe* is larger about the midst, because the ends of the *Fibres* spread further from one another, and affect a *spherical Figure*. For the several Coats of *Onions* are like so many *Leaves*, which being broader about the midst, are roll'd together like the surface of a *Cylinder*.

VI. *Why the Bodies of Trees are round.*

Almost all the *Bodies* or *Trunks* of *Trees* have the same *Figure*, *viz.* a round one, tho' they differ in length, and other manifold varieties.

The Reason of the roundness of the *Trunks* of *Trees*, is the same with that of the Roundness of the drops of *Liquid Bodies*. For as the *Cœlestial Globuli*, by their equal pressing of the parts of *water* towards their *Center*, do make them *spherical*; so the same *Globuli*, by dashing against the outside of *Trees*, drive the same to a *Roundness*. And tho' *Plants* be much inferiour in softness to *Water*, and therefore cannot be so readily *figured* by the surrounding *subtil matter*; yet this doth not hinder but that the same which is done, as it were in a moment, in the parts of *Liquid Bodies*, may be done in a larger time, and with often reiterated attempts in harder *Bodies*. So we see that *Iron Work* which was rough before, becomes smooth'd and polish'd by frequent *handling*, or even rubbing against ones Cloaths.

VII. *What is the reason of the hardness of the Barks of Trees.*

The outward part of the *Tree*, and which covers it like a *Shift*, is wont to be harder than its inward *Substance*. Hence it is that most *Trees* shed their *Bark* in the *Spring*.

The *hardness* of the outside of *Trees* proceeds from other *Bodies* that dash against it. For there are innumerable little *Bodies*, not only of the 1*st* and 2*d Element*, but also *particles* of the 3*d Element*, which continually push and dash against the *surface* thereof, and drive all the parts towards the midst. Thus our *Hands* and *Feet* by the impulse of other *Bodies*, do contract a *brawny hardness*; likewise so the *Crust* of *Bread*, and the *surface* of *Roastmeat*, grows hard by the heat of the *Fire* acting upon it, and much compacter than the inward *substance*. The reason why *Trees* in the *Spring* do lose their *Barks*, is, because the copious affluence of the *alimental moisture*, being at that time in greater abundance betwixt the *Trunk* and the *Bark*, doth loosen the *Glew* wherewith they were fastned together.

VIII. *The Aliment of Trees is not only transmitted through the Pith, nor only between the Bark and the Wood.*

But for all this, we are not to suppose with some, that all the *nourishment* of *Trees* is conveyed betwixt the *Bark* and the *Wood*; or, which is the opinion of others, through the *Pith* only, but rather both ways; tho' indeed nothing hinders but there may be a mutual communication or irroration of both these ways with each other. Forasmuch as we see there are some *Trees* which live and grow, when their Pith is quite consumed, as *Wallnut*, *Willow*, &c. as on the other hand there be *Trees* which grow after that their *Barks* are taken from them.

IX. *What is the cause of the great variety of the Leaves of Plants.*

Almost all the *Leaves* of *Plants* differ, and are of different *Figures*. For some are large and broad, as those of a *Gourd*; others small and slender like *Hair*, as the *Pine Tree*; and some thick and fleshy, as in *Purslain*, &c.

The conformation of the *Leaves* is caused by the different texture of the *Fibres*, which as they do diversly meet together, and become entangled, or else separate from one another, so they form *Leaves* of different *shape* and *figure*. For tho' the *Leaves* of all *Plants* consist of the same parts as their *Branches* and *Trunk* doth (because the thin *Skin* of the *Leaf* is nothing else but the enlargement of the thin *Skin* of the *Branch*, which partly by the occasion of new parts, and partly by the extension of its former parts becomes spread into that breadth) yet do they receive their *figure* from the various disposition of the *Fibres*. Hence it is that some *Leaves* are *long* because their *Fibres* lie only stretched out in length, others round, when the *Fibres* display themselves more winding and turning, and so for the rest. For seeing that most of them derive their original not from the *Bark* alone, but from the inward *substance*, so it is that *Alimentary Juice* is differently suck'd and strain'd, according to the disposition of the *Navel Knot* of the *Tree*, whence the diversity of the *Fibres*, and of the figure of the *Leaves* doth arise.

X. *Of the different Leaves of Plants.*

Hence it is that some *Plants* have long and slender *Leaves*, as the *Willow*; others bent and crooked, like *Orris*; others round and hollow, like *Na-*

velwort; some like a Sithe, as *Moonwort*. So likewise the *surface* of some *Leaves* is smooth and shining, as those of the *Ivy*; others hairy or downy, as the *Malabathrum*; some curled, as in some sorts of *Cabbage*; in some rough, as those of the *Fig Tree*; in some stinging and prickly, as the *Nettle* and *Thistle*; and in some the *Leaf* is nothing else but prickle, as the *Juniper Tree*.

XI. *What is the reason of the variety of Leaves that is seen in the same Tree.* Neither do the *Leaves* only of different *Trees* vary from each other, but even those of the same *Tree*; so as it will be hard to find two *Leaves* on the same *Tree* that are exactly alike. Who would not think that the *Leaves* of *Olive Trees*, above all others, were most exactly like one another? And yet you'll find that all of them differ. And the reason is plain, for tho' the *Principles* whereof they are formed do perfectly agree together, yet for all this similitude there may be a very great difference between them in relation to the magnitude, number or figure of their parts, and in many other Circumstances.

XII. *Why some Trees keep their leaves all the* Winter. So likewise it proceeds from the same cause, that some *Trees* shed their *Leaves* in *Winter*, because when the *Pores* of the *Bark* are drawn together by cold, the *Alimentary Juice* can no longer pass through them. But in those *Trees* whose *Leaves* proceed from the Inner *Bark* or *Rind*, they are not so apt to fall off, by reason of Cold, but only by the encrease of the Shoot that proceeds from the *Bud* or *Knob*, which takes possession of the *Leaves* place, and so causeth it to drop off. Hence it is that in *Brazile* and *Ægypt*, the *Trees* are ever *Green*, nor ever lose their *Leaves*.

XIII. *What is the cause of that liquor which in* Spring *time doth in great abundance proceed from some Trees.* There is a certain *Liquor* or clear *Juice*, which in the *Spring* doth in so great abundance mount upwards into the *Trees*, that it is tapt in great quantity from them, without any prejudice to the *Trees*, as the *Birch*.

The cause why this *Liquor*, at the beginning of the *Spring*, mounts up through those wooden Pipes, called *Spiral*, is because the *Lymphæducts* or *Vessels* of the *Bark*, through which it is conveyed all the *Summer*, begin but then first to be formed: Wherefore seeing it finds no passage this way, it takes its course through the *Aiery Vessels*. But as soon as the foresaid *Lymphæducts* have attained their due consistence and extension, then the *Juice* returns out of this by-way into the great road, and quitting the *Air* or *Wind-pipes*, betakes it self to these as its proper Receptacle.

XIV. *Why Leaves and Fruits, when they have attained their maturity, appear of a Yellow Colour.* *Leaves* and *Fruits*, when they are come to their full maturity, are of a *Yellow Colour*.

The Reason is, because that after the *Juice* hath been well strained and concocted in them, their *particles* become like to those that compose *Gold*, which are so rough, that they produce such a Reverberation of the *Light*, wherein the *Globuli* are less whirl'd round, than they are when they exhibit the appearance of a *Red Colour*, and more altered than those that represent a *White Colour*; which is the reason why their superficies is *Yellow*. This may be further confirmed by looking upon them through a *Microscope*, for then their *surface* appears distinguisht with many rising little Pellets or round Bodies, which leaving great Intervals betwixt them, do cause a great variety in the Reflection of the *Light*.

CHAP. II.

Of the Virtues and Efficacy of Plants.

I. *Some Vegetables are endued with a warming, and others with a cooling virtue.* SOME *Vegetables* have a *Warming Virtue*, and a power to dilate *Bodies*, as *Coleworts* or *Cabbage*, *Capers*, *Cinamon*, *Radish*, *Onions*, *Rocket*, &c. others have a power of *Cooling Bodies*, and drawing them together, as *Barly*, *Cowcumber*, *Purslan*, &c.

The *warming virtue* that is in *Plants* consists in this, that their thinnest *particles* surrounded with the *subtil matter*, do enter the *Pores* of the *Bodies*, and do so penetrate them, and agitate their parts, as to dissolve their texture, and interrupt their continuity. And therefore from this hindered course of the *subtil matter*, a kind of contest or variance ariseth, and consequently a greater *heat*, and agitation of the *Parts*. As may be seen in the mixture of *Spirit of Vitriol* and *Oil of Tartar*, which produceth an Ebullition or effervescence, because the accustomed motions of them both are disturbed, and one of them exerts its force upon the other. Again there are other *Vegetables* which produce Cold, whose insensible *particles* are of such a make, that they are able to hinder, or lessen the agitation of the parts of our *Body*. Thus *Purslan* and *Barley* are said to be Cold, because their *particles* are not easily discust by the *subtil matter*, and because they either altogether stop, or allay the motion of the *Vital Spirits*. And consequently we may conclude, that the greater *particles* of the *subtil matter* are predominant in *warm Bodies*, but the lesser and weaker in *cold* ones, because these are less agitated, and more easily reduced to Rest.

II. *The difference or several degrees of coldness in Plants.* Amongst *Vegetables*, some are cold in the 1*st*, others in the 2*d*, others in the 3*d*, and others again in the 4*th Degree*. *Coldness* in the 1*st* belongs to *Roses*, *Violets*, *Mallows*, *Barley*, *Prunes*, &c. In the 2*d* to *Sorrel*, *Lettice*, *Plantan*, *Gourds*, *Oranges*, &c. In the 3*d* to *Opium*, *Poppy*, *Purslan*, &c. In the 4*th* to *Meconium* or the juice of the Heads of *Poppy* and *Hemlock*, which latter by its extream coldness extinguisheth Life, by stopping the circulation of the Blood.

III. *Why some Vegetables provoke Lust.* *Beans*, *Asparagus*, the *Roots Satyrion*, *Parsnips*, *Rice* and such like, do provoke Lust, and encrease Seed.

For Seed consists of Blood that hath been very well concocted and strained, and the fore-mentioned *Vegetables* have the power of agitating, loosening, and so disposing the *Organs* appointed for the *generation* thereof; that as soon as the *Blood* comes to those parts, it is readily strained through them, and by this means the quantity of *Seed* is encreased. Amongst these *Earth-nuts* or *Pig-nuts* may also be ckon'd, as producing the same effect. But on the contrary, *Lettice*, *Anice*, *Hemlock*, *Purslan* and the *Seed of Rue* diminish *Seed*, because they, with their *particles* do obstruct the *Pores* of those wonderful *Strainers*; and besides, by thickning the *Blood*, make it less fit to be strained.

IV. *How Purslan restores our Teeth when set on Edge.* *Purslan* cures the *Teeth* when set on Edge, and restores the *Gums* to their natural disposition, when by the eating of any sour or harsh things, they are drawn together.

The

The Reaſon is, becauſe this *Numbneſs* of the *Teeth* proceeds from the *particles* of four *Bodies*, which penetrating through the *Gums*, draw together the *Jaw-bone*, and conſequently the *Teeth* themſelves. And foraſmuch as *Purſlan* aboundeth with *Clammy Juice*, which as ſoon as it comes into the *pores* of the *Gums*, the foreſaid four and ſharp *particles* ſtick to them, and are carried off by the *Spittle*. *Salt* is alſo ſaid to produce the ſame effect; for when we rub our *Teeth* with it, it opens the *pores* of the *Gums*, whence the *Spittle* flowing in great abundance, carries thoſe ſharp *Bodies* along with it. Thus the Root of *Pellitory of Spain*, is often with good ſucceſs held in the *Mouth* by thoſe who are troubled with the *Tooth-ach*, becauſe it draws the *humours* powerfully into the *Mouth* together with our *Spittle*. For it cauſeth a kind of *Salivation*, being held in the *Mouth* only, which may it be it would do both for a longer time, and more copiouſly, in caſe it were taken inwardly in a ſmall, but often repeated Doſe.

V. *How ſome Vegetables make Bodies hard, and others make them ſoft and flexible.*

Some *Vegetables* make *Bodies* hard and ſolid; whereas others make them ſoft and flexible.

Bodies grow hard by the mixture of ſome *Herbs*, when the *particles* whereof they conſiſt, having before been agitated by *heat*, and ſeparated from one another, are ſeized by the *Juice* of theſe *Vegetables*; which entring their *Pores*, and putting a ſtop to their *Agitation*, makes them to come nearer to one another; for by the operating of their thinner *particles*, the remaining become ſo much the cloſer united together. And on the other hand *hard Bodies* become flexible, when their *particles* being ſeparated by *heat*, a forrein moiſture getting between them, keeps them at a diſtance, and by its interpoſition makes them flexible. For the *ſoftneſs* or *pliableneſs* of any *Body* conſiſts in this, that its parts are divided from one another, and have ſomething running between them. Amongſt thoſe *Vegetables* that are endued with a conſolidating *virtue Thorough Wax* is one.

VI. *Wherein the Diuretick Virtue of Vegetables doth conſiſt.*

Some *Herbs* are endued with a *Diuretick Virtue*, as the *Roots of Fennel*, *Saxifrax*, *Smallage*, *Juniper Berries*, *Nettles*, *Bitter Almonds*, and the like, which provoke *Urin*.

This faculty in theſe *Plants* proceeds chiefly from their *heat*, becauſe their *particles* are eaſily agitated by the *ſubtil matter*. For ſeeing that obſtructions are the cauſe of the retention of *Urin*, theſe are endued with a penetrative power, and conſequently are proper to remove thoſe obſtructions which ſtop the free courſe of *Urin*. For entring into the *pores*, they attenuate and cut the tough *Flegm*, and diſſipate the grains of *Gravel*, which before, by means of ſome *ſlimy moiſture* ſtuck together, and carry them off. So that the *pores* of the *Kidneys* being looſned by this commotion, the matter contained in them becomes diſſolved, and eaſily paſſeth through them in order to its evacuation by urinary paſſages. And the caſe is much the ſame with thoſe *Herbs* that move *Womens Courſes*, by thinning and diluting their ſtagnating *Blood*, ſuch as *Saffron*, *Penny Royal* and *Sage*, becauſe by their heat they open the *obſtructions* of thoſe veſſels by which the *Blood* is conveyed to the *Womb*. And accordingly we find by experience, that almoſt all *Diuretick Plants* are hot, as *Rhadiſh*, *Rocket*, *Cinamon*, &c.

Dandelion is reckon'd amongſt *Diuretick Plants*, which by opening of the obſtructions of the *Meſeraick Veins*, conveys a greater quantity of *Urin* into the *Bladder*, than little *Children* are able to contain, and ſo makes them let go their *Urin* when they are aſleep in their *Beds*: And therefore the name of *Piſſabed* is alſo given to this *Herb*. So likewiſe the *Decoction*, *Juice* and *diſtilled water* of *Seſeli* or *Hart-wort*, or the *Seed* of it in *Powder* is very efficacious for the moving of *Urin*, breaking of the *Stone* and expelling it; and is to that purpoſe exhibited to *Infants* as well as grown Perſons. VII. *Dandelion and Seſelinum provoke Urin.*

Some *Vegetables* have an *Anodyne Virtue*, that is, ſuch as mitigates the pains of the *Fleſh*, and *heals Wounds*. VIII. *Why ſome Herbs cure Griefs and Wounds.*

All Adſtringent *Plants* are endued with this *virtue*, and which conſiſt of *Particles* like to thoſe of *Alome*; which entangling together, and penetrating the inward *parts*, do ſuck and draw out the hurtful and ſuperfluous moiſture from them; by which means the part is diſpoſed to admit and receive its due and proper *Aliment*, ſo that the *Wound* by degrees is filled with new *Fleſh*, and ſo brought to a *Scarr*.

Amongſt *Vulnerary Herbs* are accounted *Adders Tongue*, which is an excellent *Wound-herb*, whether inwardly taken, or outwardly applied. The *Green Leaves* of it do conglutinate *Wounds* and cure thoſe that are troubled with *Ruptures*: It is exhibited in the *diſtilled water* of *Horſetail* for the *healing* of inward *Wounds*: And ſome *Phyſicians* aſſure us, that the *Powder* exhibited for many days together cures all manner of *Ruptures*. The Herb called *Ladies Mantle*, is alſo an excellent *Traumatick* or *Wound-herb*, it heals, dries, adſtringeth, ſtops *bleeding*, and ſtops the *Whites* and *Courſes* of *Women*. The *Leaves*, *Top* and *Root* of this *Herb* is often added to *vulnerary Potions*, *Plaiſters* and *Ointments*. IX. *Of Vulnerary Plants.*

Thus *Marſh-mallows*, *Wheat*, the *Root* of *White Lillies* and *Camomile* do aſſwage *pain*; and *St. Johns Wort*, *Maſtick*, *Barley-flower* and *Birth-wort* do reſtore the *Fleſh* in a *Wound* or *Ulcer*. Thus *Plantan*, *Pomgranate-ſhells*, &c. have a *Glutinating Virtue*, becauſe they are Styptick or Adſtringent, and conſiſt of ſuch *particles* which entangle one another, and preſſing upon the part that lies under them, do as it were ſqueeze the ſuperfluous moiſture of it. X. *Of the uſe of Styptick or Adſtringent Herbs.*

Poppies, *Quinces*, *the Juice of Pomegranates*, and other ſuch like, ſtop *fluxes* of *blood*. XI. *Poppies and Quinces are endued with a virtue to ſtop fluxes of Blood.*

The Reaſon is, becauſe the *particles* of theſe *Bodies* inſinuating themſelves into the *Pores*, do divide the agitated *particles* of the *blood*, and by interpoſing themſelves, make a ſeparation between them: So as by this means they are no longer ſo much agitated as they were, and by this means come cloſer together. Or elſe the cauſe of this effect may be, becauſe the *Juice* of *Pomegranates*, for inſtance, lying upon the mouths of the *Veins* and *Arteries*, obſtructs their narrow paſſages, and doth not ſuffer the *Blood* to come forth. For we find by experience, that the *efflux* of *blood* is ſtopt by cold; as when in the *bleeding* of the *Noſe* we apply cold *water* to our *Temples* or *Noſtrils*, or a *plate of Iron* or a *Key* to the *Nape* of our *Necks*.

Horſe-

XII. *Of Stiptick or Adstringent Plants*

Horsetail is a powerful *Adstringent*, and is accordingly used with great success in *spitting* or *vomiting* of *Blood*, stops excessive *blood-fluxes*, and all othes *fluxes* of the *Belly*: For which purpose either the Herb it self may be taken in *powder* to the weight of one Dram, or of the decoction of it in *Wine* four Ounces, Morning and Evening, or if three Spoonfuls of the *distilled water* be drunk for two or three days together. Much the same virtue is also found to be in the *Herb* call'd *Great-water-dock*, all the parts whereof, *Stalks*, *Leaves*, *Flowers*, *Seeds*, but more especially the *Roots*, do very powerfully adstringe, harden and conglutinate. And therefore this *Herb* succesfully puts a stop to, and *heals* all putrefying spreading *Sores*, as the *Rose*, whether whole or ulcerated, *Ringworms*, *Fretting*, *Evils*, *Gangrenes*, &c. And stops all manner of *Fluxes* of *Blood* whether of *Emrods*, or of *Womens Courses*.

XIII. *Why some Herbs encrease Milk.*

Some *Herbs* conduce much to the encrease of *Milk*, as *Fennel*, *Poly-mountain*, *Milkwort*, &c. Others encrease *Seed*, as *Sparagus*, *Pine-nuts*, *Rice*, &c.

The former of these help to encrease *Milk*, because they nourish much; and therefore being mingled with the *Alimental Juice*, they open the *pores*, and remove the obstructions of those *passages* through which the *Chyle* is conveyed to the *Breasts*. For it is certain, that by a slight straining only, the *Chyle* becomes changed into *Milk*. And the Reason is much the same as to those Herbs which promote the *generation* of *Seed*; save only in this one thing wherein they differ from the former, *viz.* that they abound with more *Salt*, and diffuse a greater *heat* through the *Body*. By which means the *Organs* appointed by nature for the *generation* of *Seed*, are more opened, and consequently give a more free passage to the *matter*.

XIV. *Why Wormwood, Bitter Almonds, &c. destroy Worms.*

Wormwood, *Bitter Almonds*, *Hartshorn Philosophically* calcin'd, &c. kill *Worms* and expel them out of the Body of *Men*.

The Reason is, because these Simples are *bitter*: For *Worms* delight only in things that are of a sweet *taste*, and with which they are nourished, as well as they were generated at first from them. For *bitter things* consist of rough *particles*, and which on all sides are surrounded with *prickles*, and consequently entring into the soft and spungy *Bodies* of *Worms*, they rend and tear their *inwards*. And by this means the *Worms* are killed, or avoiding the said *bitter things*, are expell'd by *Stool*, or sometimes tending upwards, are voided at the *Mouth* or *Nostrils*. *Corallina* or the *Sea-moss* that grows upon *Coral* is very famous for its efficacy in destroying *Worms* and expelling them, being given in *Powder* mixt with *Wine*, *Milk*, or the extract of *Cassia*, to the quantity of half a dram to *Children* under 14 years of age, and to those who are elder to the quantity of a whole dram.

XV. *How the qualities of the Herbs that Animals feed upon, come to be communicated to their Milk.*

Nurses Milk oft partakes of the Odor and Taste of the Herbs they have eaten: And it is notorious that Cows according to the difference of the Herbs they feed upon, do give a different *Smell*, *Taste* and *Colour* to the *Butter* that is made of their *Milk*.

The Reason is, because the *Milk* is made immediately of the *Chyle*, and not out of the *Blood*, which hath been formerly the common opinion. For the *Chyle* is carried from the *Stomach* to the *Breasts*, and by some particular passages is carried from the *Guts* to the Receptacles of *Milk*. This is confirmed by the daily practice of *Physicians*, who give Purges to *Nurses*, when their *Nurslings* stand in need of being *purged*, because the purging quality of the *Medicin* is communicated from the *Chyle* to the *Milk*; but not to the *Blood*, which takes a much longer circuit through the *windings* of the *Heart* and *Arteries*, and undergoing several changes, cannot possibly retain the *Cathartick Virtue* of the *Medicines*. For how can it be that, when a *Nurse* drinks *Milk* ting'd with *Saffron*, within half an hour after the *Milk* in her *Breasts* should be of the same *colour*, *smell*, and *Taste*, if *Milk* were made of the *Blood*, and not of the *Chyle*, which by some secret and short passages, is conveyed to the *Breasts*? All which is further confirm'd by that Leaf of *Succory* which a Surgeon took out of the *Breast* of a *Roman Matron*, and which she had eaten the night before.

CHAP. III.

Of the obvious, or known Qulities of Plants.

I. *Why Vegetables are commonly Green.*

GREEN is the common *colour* belonging to *Plants*, not only to them that are yet young and flourishing, but also to some when they are old and withered.

It is evident from what hath been said before, that the nature of *Colours* depends on the various *Reflexion* of *Light*, and the various disposition of the *surfaces* of those *visible Bodies* upon which it *falls*. So that those *Bodies* are of different *Colours*, whose outward *particles* are variously posited, and reflect the *Beams* of *Light* to the *Eye*. Thus the *Green Colour* we find in growing *Plants*, proceeds from the copious *moisture* wherewith they abound, the *particles* whereof are so mixed with other foreign *particles*, that they reflect and refract the *Light* in the same manner as those *Bodies* do, which in *Rivers* or standing *waters* are turned into *Moss*. And thus according to the various *mixture* of this moisture with the *External matter*, a different degree of *Greeness* is observed in *Vegetables*. For some of them are of a most deep *Green*, and such as these abound most with *moisture*, but their *juice* is not so exactly percolated as that of some others. Others are of a more pale *Green*, that is, such whose *Leaves* are of longer standing, or whose *Fruits* are come to their full maturity. Because in process of time a great part of the *moisture* flies away, and the crude or raw *Juice* being digested by *heat*, arrives at perfect *Ripeness* and *Concoction*. Hence it is that the *Leaves* of *Plants* sometimes put on other *colours*, and become *Yellow* or *Red*.

II. *Why the Fruits of Plants are of various colours.*

And whereas *Fruits* do very much differ in their *colours*, *Pears* and *Apples* being whitish, *Plums* yellow, Blue or Purple, *Cherries* Red or Black; this proceeds only from the various percolation of their *Juices*, and the different *texture* of their *parts*. For it is apparent that the *Juice* in an *Apple* or *Pear* is first coagulated into *Froth*, which afterwards becomes a hard *Flesh*; whereas in *Apricocks*, *Figs*, *Cherries* and *Grapes*, the same *Juice* is turned into a much softer substance. And therefore no wonder

wonder if from this different diſpoſition of their *particles*, ſuch different *colours* are produced in them.

III. *Why the Roots of moſt Plants are white.*

The *Root* which lies hid in the *ground*, is commonly more tender than the other parts of the *Plant*, and for the moſt part of a white *colour*.

The Reaſon is, becauſe the *particles* of the *Juice*, which by heat are agitated within the *pores* of the *Roots*, endeavour to get out, and accordingly in effect many of them do break their Priſon and fly away. But being hindred by the *Earth*, that lies about them, from going further, they return to the *Root* again, where undergoing a 2*d* Concoction, they make the *Root* the more tender. And foraſmuch as that moiſture which imparts a *Greenneſs* to the *Leaves*, is by the warmth of the *Earth* changed into *froth*, this makes the *Root* to look white, becauſe according to the multipliciy of its *ſurfaces*, it reflects various parts of *Light*. Hence it is common with *Gardners* to cover ſome *Plants* with *Mould* or *Sand*, as *Succory Endive*, *Cabbage*, *Leeks*, &c. to make them tender, and to give them a white colour.

IV. *Whence the Odours of Herbs do proceed.*

Some *Vegetables* are much more *odorous* than others: For ſuch as grow in *Arabia*, and other hot *Climates*, are of a ſtronger fragrancy than others; as appears in *Cinnamon*, which keeps its *odour* for many years.

The Reaſon is, becauſe the *odoriferous Steams* that proceed from *Bodies*, do conſiſt of *ſulphurous* or *fat matter*, which being attenuated by *Heat*, and reaching the *mamillary* proceſſes of the *Noſtrils*, doth affect them either ſoftly and pleaſantly, or harſhly. And foraſmuch as thoſe *Vegetables* which grow in hotter *Countries*, are more expoſed to the *Rays* of the *Sun*, which exhale the *watry humours*, the *fat* and *ſulphurous humour* only remains, which furniſheth the matter of all *Odours*, and is the more readily conveyed to our *Noſtrils*, as being diſentangled from the encumbrances of the *watry particles*. Now that this *fat* and *ſulphurous matter*, is that wherein the *Odours* of *Bodies* doth conſiſt is evident from hence, becauſe when this *ſulphurous matter* is taken away by *diſtillation*, the *odour* or *fragrancy* that is in that *Body* is taken away together with it, as appears in the *Caput Mortuum*, or remaining *Dregs* that are left in the *Alembick* after *diſtillation* which hath no ſcent at all. And therefore it is no wonder, that thoſe *Plants* are of a ſtronger *ſcent*, whoſe fat and *oleous particles* are reſolved by *heat*; and that thoſe are of a weaker *ſcent*, and do leſs affect our *Organs*, which grow in moiſt and wet *places*. Becauſe their *Juice* is not throughly digeſted for want of *heat*, and the abundance of *moiſture* hinders the due concoction of the *ſulphurous matter*, and keeps it from being dilated and *rarefied*. Hence it is that ſuch *Plants* as theſe do *ſmell* more ſtrongly when they are dry, than when moiſt and green, becauſe then the *odorous particles* breath forth more freely, as being no longer drowned or entangled in *moiſture*.

V. *Why Fruits in their progreſs to maturity change their ſmell.*

Fruits have not always the ſame *ſmell*, but change the ſame according to their ſeveral ſtations: For ſuch as are near their perfect Ripeneſs, do *ſmell* more ſweetly than thoſe that are green and unripe.

The Reaſon is, becauſe ſince *odour* conſiſts in the dry and thin parts of *Bodies*, the ſame is made the more pleaſant, and doth more ſoftly affect the *Organ* of *ſmelling*, by how much the matter of the ſaid *odorous Steams* is more thin and better digeſted: Which certainly is then, when *Fruits* are arrived to the pitch of perfect maturity, and ready to be gathered. For then by reaſon of a long decoction the *Juice* is more purified, the parts digeſted, and their perfect percolation advanced. And when this happens, no wonder if copious ſteams proceed from *Fruit* at this time, and more pleaſant *ſmells* than when they are only in their firſt tendency to maturity.

VI. *The cauſe of the different Taſte that is in Fruits.*

Almoſt all *Fruits* are diſtinguiſh'd by their *Taſte*, as affecting the *Tongue* and *Palat* after a peculiar manner. Some are of a harſh taſte, as *Sloes*; other of a ſmart or ſharp taſte, as *Onions*, *Muſtard*, &c. ſome ſweet, as *Wheat*; ſome ſower, as *Sorrel*; ſome bitter, as *Wormwood*, *Aloes*, &c.

This difference of *Taſte* in *Vegetables*, proceeds from the different *texture* of their *particles* whereof the *Fruit* conſiſts, and which entring the *Organ* of the *Taſte*, do affect the ſame. For theſe little *Bodies*, when they are mixed with the *Spittle*, have the power of moving the *Tongue*, and impreſſing ſeveral affections upon it. Wherefore the *particles* of ſuch *Bodies* which draw the *Tongue* together, and make it rough and harſh, are ſaid to be of a harſh or ſower and adſtringent *taſte* as unripe *Fruit*. And ſuch whoſe *particles* prick the *Tongue*, and divide it with the ſenſe of a kind of dilating *heat*, are ſaid to be of a ſharp, ſmart and biting *taſte*, as *Pepper*, *Muſtard*, *Arſmart*, &c. Thoſe which ſmooth the *Tongue*, and pleaſantly affect, are called ſweet, as *Licoriſh*, &c. Thoſe which prick the *Tongue*, and affect it with a conſtringent ſenſation of cold, are called ſharp and ſtyptick, as *Cypreſs Nuts*, *the Rind of Pomegranates*. Such as impreſs a kind of dryneſs upon the *Tongue*, are called bitter, as *Aloes*, *Coloquintida*, *the Leſſer Centaury*, *Wormwood*, &c. So that the whole difference of theſe *Bodies* conſiſts only in this, that their *particles* are of a different magnitude, and vary alſo in their *Figure*, *Motion*, *Hardneſs*, *Lightneſs* and ſeveral other ways.

VII. *Why the ſmoak of Tobacco ſeems ſweet after the taſting of Vitriol.*

Thus we find by daily Experience, that when a Man hath taſted *Vitriol* before his taking a *Pipe* of *Tobacco*, the *ſmoak* will ſeem as ſweet to him as *Hony*, and with a pleaſant tickling will affect his *Organ* of *Taſte*; becauſe the *ſtyptick* or adſtringent *ſaline particles* that are in the *Vitriol*, being impregnated with the *ſulphureous particles* evaporated from the *Tobacco*, do produce a ſweet *Taſte*.

VIII. *Why Garlick and Onions loſe their bitterneſs by boyling.*

Some *Fruits* do change their *Taſtes*, ſo as that thoſe which before were *biting* and *bitter*, become *ſweet* and *grateful*; thus *Garlick* and *Onions*, being boiled in *water*, loſe their *Acrimony*.

The Reaſon is, becauſe the *Taſte* of *Fruits* conſiſts in their ſtiff and pricking *ſaline particles*. And therefore *Garlick* and *Onions* become ſweet and pleaſant when they are boil'd, becauſe the *fire* opening their *pores*, makes way for the *ſaline particles* to exhale. Hence it is alſo, that all *Fruits*, as they ripen, grow ſweeter; foraſmuch as upon the evaporating of their moiſture, their *ſalt Armoniack* and other volatil ſaline *particles* fly away, leaving theſe only behind them that procure a ſweet *Taſte* to the *Fruits*. And it is for the ſame

reaſon that *Garlick* and *Onions*, being ſoaked in boiling *water*, acquire a milder Taſte, *viz.* becauſe the *particles* of *Salt* that were in them are diſſolved by the *water*, and being intangled with it, do evaporate into the *Air*. Thus the Root of *Arum*, when new took up out of the *Ground*, is of an extream ſmart, biting and pungent *Taſte*, but being dried, and eſpecially being long kept ſo, becomes inſipid, and conſequently inefficacious and of little or no virtue.

CHAP. IV.

Of the Ocoult Qualities of Plants.

I. *Wherein the Purgative Virtue of Plants doth conſiſt.*

THE *Occult Qualities* of *Plants*, are generally ſuch as belong to *Medicin*, and are diſcernible by Reaſon, rather than by the *Senſes*. Amongſt theſe we will firſt ſpeak of the *Purgative Virtue* or *Quality* wherewith ſeveral *Plants* are endued, and by means whereof they expel excrementitious and corrupt *humours* out of the *Body* by *ſiege*. Thus *Rhubarb* and *Scammony* purge *Choler*; *Sena*, *Polypody of the Oak*, *Dodder of Thyme*, *Hellebor*, &c. *Black Choler* or *Melancholy*; *Carthamus* or *Wild Saffron*, *Agarick*, *Herb Mercury*, *Spurge*, and the ſeveral ſorts of it, *Phlegm* and *watry Humours*; *Fumitory*, *Caſſia Fiſtula*, *Prunes*, *Bugloſs*, purge and cleanſe the *Blood* from its dregginеſs.

The Opinion of the Antient *Phyſicians* was, that *Medicins* that are endued with a *purgative virtue*, exert the ſame by a *likeneſs* of *ſubſtance* to thoſe *Humours* they attract and expel out of the *Body*. And therefore GALEN who made the *purging virtue* of *Simples* to conſiſt in attraction, *Simpl. Lib.* 3. aſſerts a *ſimilitude* between the *ſubſtance* that *purgeth*, and that which is *purged*: So that *Purging Medicins*, according to his Opinion, do pick out ſome particular *humour*, which they expel out of the *Body*, *viz.* ſome, *Choler*; others, *Phlegm*; ſome, *Melancholy*; &c. But I cannot be induced to comply with this opinion, ſeeing that daily experience teacheth that the *Melancholy Humour* which is tough and clammy, is expelled by *Caſſia* and *Coloquintida*, which have no affinity at all, or likeneſs of ſubſtance with that *Humour*. So likewiſe the watry or ſerous *humours* of Perſons afflicted with the *Dropſie*, are evacuated by *Aloes* and *Rhubarb*, when yet there is no ſimilitude between their *ſubſtance* and that of the Moiſture they expel.

II. *There is no need of this ſimilitude between the Medicins and Humours they evacuate.*

But if we examin this point more narrowly, we ſhall find that *contraries* are rather cured by *contraries*. For what *Phyſician* doth not know that the deterſive quality that is in *Wormwood* conſiſts in its *ſulphurous Spirit*; that the Roots of *Plantan* and *Bugloſs* do thicken thin *Choler* by the clammy conſiſtence of their *Juices*; that all the *Sorrels*, *Juice of Limons*, and all *Acids* do thin and cool the *Blood*, and allay its Fury, not with aduſt *Sulphur*, but with their acid and cold *Spirits*? Beſides infinite other *Simples*, which either by ſoftning or aſſwaging do purge thoſe *Humours* with which they have no ſimilitude at all.

III. *Purgative Plants exert their efficiency by fermentation.*

Conclude we therefore, that *Purging Medicins* expel *corrupt humours* by *fermentation* in this manner: The *Medicament* as ſoon as it is taken into the *Stomach*, doth there meet with a ſharp *humour*, which flows from the *Heart* through the *Arteries*, whereby, as with an *Aqua-Fortis* it is diſſolved: But foraſmuch as it is of a different ſubſtance from the ſaid *Juice*, and therefore doth not mingle with it without difficulty, the *Juice* by means of the *Medicin*, begins to ſwell and *ferment*; as we ſee that Wine doth, by reaſon of its *Sulphureous Lees*, or by the mixture of ſome *Heterogeneous Subſtance* with it. Afterwards this *Medicament* is carried to the *Lacteal Veins*, and from thence to the common *Receptacle* detected by *Pecquet*, and thence to the *Ductus Thoracicus* or *Breaſt-paſſage*, and ſo is conveyed into the left *Axillary Vein* where it is confounded with the *Blood*. But becauſe by reaſon of the *Heterogeneouſneſs* of its *Parts* it cannot be united with the *Blood*, therefore it joins it ſelf with the *Choler*, *Phlegm*, or other *Humour* lurking in the *Blood*. And foraſmuch as it is carried with the *Blood* throughout the whole *Body*, it doth in its paſſage twitch and prick the parts, whereupon they become contracted, and ſqueez out the *humours* that were lodged in the *Veſſels* belonging to the ſaid parts. Now while all the parts of the *Body* do thus ſucceſſively expel theſe *humours*, and they find no refuge for themſelves in the *Veins*, they are driven towards the *Stomach* and *Guts*, which they irritate to expulſion, and ſo are evacuated with the common *excrements* of the *Food*. Thus according to the difference of the *Plants*, different *Humours* are expelled; as *Choler* by *Scammony*, *Phlegm* by *Coloquintida*, *Melancholy* by *Black Hellebor*; *Black Choler*, ſo called, by *Dodder* of *Thyme*, *Sweat* by *Sarſaparilla*, &c.

IV. *What is the cauſe of the Vomitive Virtue of ſome Plants.*

Some *Vegetables* excite *Vomiting*, and evacuate *Humours* by the *Mouth*; as the *middle Bark of Wallnut-trees*, *Coloquintida*, *Broom Leaves*, *Nux-vomica*, &c.

The *virtue* of theſe *Vegetables* is not much unlike that of *Purging Medicaments*, ſave only in this, that their *operation* is more ſwift, by exciting a quicker *Fermentation*. *Corrupt Humours* therefore are expelled by *Vomit*, when the *Stomach* being vellicated or twitched by the *particles* of the *Medicament*, becomes ſo contracted and drawn together, that it can no longer contain the matter that is in it, and conſequently drives forth the *Humours* that oppreſs it. And therefore it is dangerous to exhibit *Vomiting Medicaments* to thoſe who are troubled with the *Phthiſick* or *Conſumption*, or that have ſtrait *Cheſts*, leſt the *Stomach* ſhould not have room enough to diſplay it ſelf in *vomiting*, or by a too violent compreſſion of its *Fibres* ſhould occaſion a dangerous *Convulſion*. This *vomitive virtue* is found in the *Herb Groundſel*; the *Juice* whereof being taken in *Beer*, or the decoction of it in *Water* with *Currans* or *Hony*, affords a gentle *Vomit*. So the *Water* of a certain *Thiſtle* called *Silybum*, being drunk cauſeth *vomiting*: And the Root of the *Herb Thapſia*, as well as the *Juice* or *Decoction* thereof, doth *purge* upwards and downwards with great violence, and therefore is not ſafe to be given inwardly.

V. *Of the different virtues that are in Plants.*

Some *Plants* cure the *Diſeaſes* and *Griefs* of ſome parts: Thus *Betony*, *Hyſop*, *Maiden-hair*, &c. are good for the *Head*; and particularly *Sweet Marjerom* do help the cold affections of the *Head*

Head and *Brain*, which way ſoever it be taken; the Powder of the dried *Herb* ſnuft up, provokes *Sneezing*, evacuates *Phlegm* and ſtregthens the *Brain*; and the ſame effect is cauſed by the Juice of the *Herb* ſnuft up. *Borrage*, *Angelica*, *Bugloſs* and *Balm*, ſtrengthen the *Heart*, and remove the Diſtempers of it: *Wormwood*, Sage and *Aniſeed* are good for the *Stomach*. Thus *Endive* and *Succory* are appropriated to the *Liver*, and afford a moſt excellent *Remedy* to remove the *Heat* of the *Liver* or its obſtructions, which way ſoever it be taken, whether the *Leaves* of them be eaten raw or boyled, or the *Juice*, diſtilled *Water* or Decoction of them; and therefore greatly commended in *Fevers*.

The Reaſon of all theſe manifold *virtues* is to be lookt for in the different *texture* of their parts. For ſeeing that the diſpoſition of the *parts* of the *Head*, *Heart*, *Stomach* and *Liver* is different, they muſt conſequently be cured by different *Remedies*. Now *Bodies*, according to their various *Figures*, produce alſo various effects. Thus ſubtil and thin *Bodies* are aperitive or opening; thick *Bodies*, incraſſate; ſharp and biting are abſterſive, and cutting or inciding.

VI. *Why the Odour of Herbs ſometimes performs the ſame effect which the ſubſtance of the Herb taken doth produce.*

There are ſome, who with the ſmell of *Herbs* or *Drugs*, are *purged*, much after the ſame manner as if they had taken a *purging Medicament* inwardly. Thus I knew an *Engliſh* Gentleman in *Flanders*, who when ever he paſſed by an *Apothecaries* Shop, was moved to go to Stool, as if he had taken a *Purge*.

The Reaſon of this was, becauſe the *particles* flowing from the *Purgative Drugs* or *Medicins*, did ſo agitate the *Brain*, and conſequently the *Nerves* of this Perſon, that thereby they put the *Humours* in the ſame motion, as might have been expected from a *purging Medicin*; *viz.* by the ruſhing of the *Spirits* againſt the *Fibres* of the *Stomach* and *Guts*.

VII. *Why Cats are ſo much delighted with Catmint.*

Cats take a very particular pleaſure in *Catmint*, tumble themſelves over it, and ſeem wonderfully pleaſed with the touching of it.

The Reaſon is, becauſe *Catmint* conſiſts of ſuch *particles* as have a great *ſympathy* and agreement with the *Brains* of *Cats*: For ſeeing that *Beaſts* are not led by *Reaſon* or *Judgment*, but by a meer impulſe of Nature, or rather by the diſpoſition or make of their *Organs*, they cannot but be allured by thoſe objects that preſent themſelves to them; which could not be, except ſome *ſteams* did proceed from them, with the ſcent whereof they are affected. Wherefore we may conclude that in *Catmint* there is ſuch a *Texture of Fibres*, as hath a great agreement and correſpondence with that of the *Brains* of *Cats*.

VIII. *Why a piece of Pompion being put into a Pot wherein Fleſh is boyling, makes the ſame tender.*

A piece of *Pompion* put into a *Pot* in which *Fleſh* is boyling, doth make the ſame more tender than ordinary.

The Reaſon is, becauſe the *Pompion* abounds with ſtrong *Spirits*, and a *ſowriſh Juice*: Now it is manifeſt that all *ſowr things* are endued with a reſolving *virtue*, which daily experience ſhews us concerning *Vinegar*. And PLINY aſſures the ſame concerning *ſharp pointed Docks*, *viz.* that being boyld with *Fleſh*, it makes it more ſoft and tender; becauſe its ſharp and corroding quality doth diſſolve the *Texture* of the *Fibres*.

The ſame *virtue* is by *Botaniſts* attributed to *Hippolapathum* or *Patience*, which renders the oldeſt and tougheſt *Fleſh*, when boyl'd with it, tender and fit to be eaten. For this *Herb* being of a ſlippery and moiſt nature, it makes the oldeſt and tougheſt *Beef*, or any other Meat, ſoft and tender. And for this reaſon the uſe of it was very frequent amongſt the *Antients*, becauſe it renders the Meats boyl'd with it, eaſie to be concocted, and beſides, makes the *Body* ſoluble.

IX. *The ſame virtue is alſo found in the Herb Patience.*

Some *Plants* are endued with a pernicious power of *killing Animals*. Thus the Herb *Napellus*, which is a kind of *Wolfsbane*, doth by its extream heat burn the *Body*, and ſcorch and conſume the firmer parts of it.

X. *Why ſome Plants are of a deleterious quality, and kill living Creatures.*

This effect is alſo to be attributed to the *figure* and *motion* of *Plants*, by means whereof they exert their *virtues*, and perform thoſe effects we are ſurpriſed at. For it is moſt conſentaneous to reaſon, that the *parts* whereof *Poiſons* conſiſt, are very *ſtiff*, *penetrating*, *hard*, and armed with *Prickles*: In the ſame manner as we find by the *Microſcope* that *Nettles* are armed with an infinite number of *prickles*; wherefore ſuch *Bodies* as theſe being fermented in the *Stomach*, and mingled with the various *Humours* therein contained, doth excite a very violent Ebullition, eſpecially when it is conveyed out of the *Vena Cava* into the left *Ventricle* of the *Heart*, and from thence into the right. For its *heat* being here encreaſed, it breaks forth with extream violence, and ruſhing upon the inward parts, doth with its ſharp points and prickles penetrate, corrode and tear their *ſubſtance*.

Again, there are other *Plants* which are of a contrary *virtue*, and which kill *Animals* by their *coldneſs*, as *Hemlock*, which kills *People*, or makes them go *mad* or *ſenſleſs*; and *Scammony* which doth ſo draw the *Wind-pipe* together, that it ſometimes *choaks* and *kills Men*.

XI. *Hemlock kills by its great coldneſs, and Scammony choakes men by drawing of the Wind-pipe together.*

The efficacy of theſe *Plants* conſiſts in this, that they ſtop the *circulation* of the *Blood*, and ſuppreſs the Native Heat; for ſeeing that the motion of the *Blood* is ſmooth and eaſie, as paſſing through all the parts of the *Body* with an even Courſe, when ever cold, or ſlowly moved *Bodies* do enter into the maſs of it, they diſturb and confound the motion thereof, and dull or diminiſh the *heat* of the *Plants*: And being through the *Veins* carried to the *Heart*, they cool it, and reduce it to a kind of lukewarmneſs. For whether the *agitation* of the *particles* of the *Poiſon*, be contrary to the motion of the *Blood*, or whether the ſlowneſs of their motion do deſtroy its heat, ſtill the ſame effect will follow, if by their entring into the *Heart* a change is made, and the *Orifices* through which the *Blood* is conveyed thither, be never ſo little obſtructed. For no other reaſon can be aſſigned why the eating of *Hemlock*, makes perſons *mad* or *ſenſleſs*, but becauſe the ſaid *Herb* taken inwardly, cauſeth diſorderly twitchings or vellications of the *Brain*, by which means the Spirits are hindred from their natural and due motion through the *Fibres* of it.

XII. *How the Plague is propagated.*

Thus *Phycitians* tell us, that when the *Air* is corrupted by noxious *exhalations*, the *Plague* and other *Epidemical Diſeaſes* are produced; for the *particles* of the *Peſtilential Steam* being taken in with the *Breath*, and inſinuating themſelves into the *Blood*, do confound the natural ranging of its par-

particles: Even as the *Rennet* when mingled with *Milk*, and diffuſed through the *ſubſtance* thereof, doth ſo change the ranging of its parts, as to make a fixt *Body* of that which was fluid.

XIII. *The Root of the Tree* Baxana *is preſent Poiſon.*

And probably it is for no other reaſon, that the *Root* of a certain Tree called *Baxana*, growing in a Kingdom belonging to the *Dominions* of the *Great Mogul*, doth immediately cauſe death to them that take it, by ſtirring up a ſluggiſh drowzineſs or heavineſs over the whole *Body*; but becauſe as ſoon as it enters into the *Blood*, it doth by its coldneſs allay the *heat* of the *Heart*, and by this means diminiſh the *heat* that is in the extream parts of the *Body*, and afterwards by degrees cools the *Blood* that is in the *Veins* and *Arteries*, whereby ſoon after the *Heart* it ſelf is ſeiſed and nummed. But what is moſt wonderful is that *Hiſtorians* tell us, that the *Fruit* of the ſaid *Tree* is altogether harmleſs, and is ſafely eaten by the *Inhabitants*; the reaſon whereof probably is, becauſe the *Fruit* is better concocted by the heat of the *Sun*, and the cold *Humours* diſcuſt and exhaled.

XIV. *Hemlock is not hurtful to all living Creatures.*

Neither is *Hemlock* always hurtful to all *living Creatures*: For *Starlings*, if we may believe GALEN, do commonly feed upon it, and without receiving the leaſt hurt thereby. And ſome *Anatomiſts* tell us, that they have found the Crop of a *Buſtard* full of *Hemlock Seeds*, which had only 4 or 5 grains of *Wheat* mingled amongſt them. And the Poet LUCRETIUS adds,

Thus with cold Hemlock Goats we fatted ſee,
Tho' it to Man a preſent Poiſon be.

Wherefore it appears that *Hemlock* is not deadly to all *Animals*; ſeeing that the uſe of it inwardly is commended by Modern *Phyſitians* in the *Swelling* and *Inflammation* of the *Spleen*, as the *Juice* of it is an ingredient in *Splenick Plaiſters* to ſoften the hard ſwellings thereof.

XV. *Whence Wild Fig-trees hath the power of taming a mad Bull*

A *Mad Bull* is tamed by tying a twig of the Wild *Fig-tree* to his *Neck*; and the ſame *virtue* is alſo attributed to the *Herb antheris*.

This may come from the *Steam* proceeding from that *Plant*, which being diffuſed through the Wild *Bulls Brains*, doth ſo affect the *Nerves* thereof, as to caſt him into a ſtupidity or numneſs, whereby he loſeth all his ſtrength. The ſame is related by ſome concerning the *Lion*, that as ſoon as he is but toucht with the Herb *Adamantis*, he lies with his Mouth open upon his Back, as having quite forgot his wonted ſtrength and fierceneſs.

XVI. *Whence ſome Herbs have a virtue of reſiſting Poiſon.*

Some *Herbs* are endued with a *virtue* againſt *Poiſon*, and therefore are called *Antidotal*, or *Alexipharmacal*. Thus *Purſlain* cures the *biting* of *Serpents*; *Endive* that of *Spiders*. *Wine* reſiſts the cold Poiſon of *Hemlock*. And beſides theſe, *Marygolds*, *Carduus Benedictus*, *Angelica*, *Rue*, &c. do powerfully reſiſt Poiſons, and break the force of them.

The Reaſon is, becauſe theſe *Plants* conſiſt of ſuch *parts* as have a great affinity with the *particles* of thoſe *poiſons* which they overcome, and therefore eaſily join with them; and by this means do by their interpoſition break the force of them, and change the ranging and figures of thoſe *Bodies*, which without their conjunction, do fix and coagulate the *Blood*. For *hot things* do eaſily diſcuſs and overcome the violence and malignity of cold *Poiſons*; and *therefore the Publick Executioner adviſeth* Crito, *that he ſhould not ſuffer* Socrates *to diſpute too earneſtly, leſt his Body ſhould be too much heated*, SCALIGER Exercit. 52. Moreover cold *Plants* alſo are found to be of uſe for the curing of cold *Poiſons*, by drawing them out of the *Body*; becauſe when the *Blood* is coagulated by *cold*, it is diſſolved again by the ſupervening *liquor*, and its nimbleſt *particles* are put into motion again; and both of them being thus confounded together, are variouſly agitated, and at laſt thruſt together out of the *Body*.

CHAP. V.

Of the Sympathy and Antipathy of Plants.

I. *Why the Female Palm-tree delights in the Neighbourhood of the Male Palm.*

THE *Female Palm-tree* ſeems to delight in the nearneſs of the *Male Palm*, and becomes more *fruitful* by ſtanding in its Neighbourhood; and therefore inclines her *Top* and *Branches* that way; and being removed farther from the *Male Palm*, languiſheth, and ſometimes withers and dies.

The Reaſon of this *ſympathy* between both theſe ſorts of *Palm-trees*, is a certain ſteam which proceeds from the *Male Palm* to the *Female*, which abounds with a *ſeminal* and fœcundating *virtue*, and inſinuating it ſelf into the *Female Plant*, make her more *flouriſhing* and *fruitful*. For it ſeems that in this caſe it happens with the *Palm-tree*, as with *Hens*, which lay *Eggs* indeed without the *Cocks Treading*, but yet the ſaid *Eggs* cannot be *animated* or become prolifick, tho' the *Hen* ſit never ſo long Brooding upon them. So *Herbs* being endued with a *vegetating virtue*, as well as *Animals*, which propagate themſelves by a moiſt *Seed*, do transfuſe the *generating virtue* and *vital ſpirit* from one to another by mutual embraces, and this by a tacit conſent of nature, and are cheriſhed, animated, flouriſh, and produce *Fruits* and *Seeds* by a hidden and ſecret inſpiration.

II. *Why Cucumbers and Gourds have ſuch an averſion from Oyl.*

Cucumbers and *Gourds* have an *antipathy* againſt *Oyl*; ſo that when ever it is put to them, they ſeem to turn away from it.

The Reaſon is, becauſe the *Effluvia* that proceed from *Oyl*, conſiſt of ſuch *particles*, as do with their ſharp *prickles* and *points* run into them, and cauſe their *Fibres* thereby to be contracted, ſo as that they ſeem to avoid, or withdraw themſelves from the *Oyl*.

III. *Why the Ivy hath an Antipathy againſt a Vine.*

The ſame *Antipathy* is found between the *Ivy* and the *Vine*, inſomuch that a *Cup* made of *Ivy* will not admit of *Wine*. For if we may believe CATO, if a *Cup* be made of *Ivy*, and be filled with *Wine*, if the ſame be mingled with *Water*, immediately the *Wine* will run out of the *Cup*. And it was probably for this cauſe that the *Ivy-tree* was conſecrated to *Bacchus*, foraſmuch as it reſiſts *Drunkenneſs*, and removes pains of the *Head*, cauſed by too much *drinking* of *Wine*.

IV. *Why Cabbage is ſaid to be an Enemy to the Vine.*

Cabbage is ſaid to abhor the neighbourhood of the *Vine*: And *Rue* to be an Enemy to *Hemlock*.

One

One *Plant* is ſaid to be friendly or inimical to another, not by reaſon of any *Sympathy* or *Antipathy* that is between them: For ſuch a concord or enmity is not to be found among *Plants*; but on the contrary when one *Plant* is nouriſhed with the ſame kind of *Juice* that another is, their Neighbourhood becomes hurtful to one another, becauſe then the one robs the other of his due *Aliment*. But if two *Plants* are maintained by a different *Juice*, then they are ſaid to *ſympathize* together, as *Rue* flouriſheth, when planted near to a *Fig-tree*, becauſe they draw a contrary *Aliment* from the *Ground*; the one of them taking in a moiſture which gives it a *ſweet taſte*, and the other ſuch as affords it a *bitter taſte*. And it is for the ſame Reaſon that a *Roſe-tree* which grows near *Garlick*, brings forth ſweeter ſcented *Roſes* than that which is in the neighbourhood of other *Plants*, becauſe the noiſome and offenſive *Juice* being ſuckt in by the *Garlick*, the purer and more fragrant *Juice* is left for the *Roſe-tree*.

V. *Why ſome Herbs avoid touching.*

The *Live Plant* ſo called, to which the *Arabians* and *Perſians* give the name of *Suluc* or *Saluc*; and to which *Philoſophers* have given the Title of *Chaſte* or *Shamefac'd*, if whilſt it is *Green* it be touched never ſo ſlightly with ones *hand*, or be never ſo little ſqueez'd with ones *finger*, it preſently ſtarts back, and contracts it ſelf; but no ſooner is the hand of him that toucheth it withdrawn, but it returns again to its natural poſture. And THEOPHRASTUS tells us, in the 4*th* Book of his *Hiſtories*, *Chap.* 3. that there was a *Tree* growing about *Memphis* in *Egypt*, which to outward appearance was *thorny* and *prickly*, and its *Leaves* reſembled *Fern*, the *Branches* whereof being touched, the *Leaves* immediately fall and wither, and afterwards recovering their ſtrength, riſe again and return to their former ſtate, as is expreſt in the *Figures*.

Figure 27.

HENRICUS REGIUS, in the 4*th* Book of his *Natural Philoſophy*, endeavours to give a reaſon of this *Miracle*; ſuppoſing in the *firſt place* this *Plant* to be of a very tender and pliant *ſubſtance*, which upon the leaſt touch is wounded and bruiſed. 2*dly*, That there are ſome inward *Nerves* or *Fibres* marked 1. 1. wider than other outward ones, ſigned 2. 2. by which means the *Steams* proceeding from the *Earth* T. are in more abundance ſent up into the upper *Fibres* of the *Leaves b b*, than into the lower *c c*. For when a Hand toucheth the upper part of the *Leaves* about *d d* of the *Figure* A, the *Spirit* contained in thoſe parts, are by the inward *Nerves* 1. 1. carried downwards, and conſequently open the Flap Doors and Pores that are about 5 5, and paſs out of the wide Nerves into the narrower 2 2. And foraſmuch as they cannot go downwards, becauſe they are hindred by the upward tending Flappets 6 6, they aſcend, and in their aſcent ſhut the Flappets 4 4, opening from the narrower Nerves to the wider, and thus neceſſarily paſs to the inward Muſcles or Fibres *c c*, and blowing them up, draw the *Leaves* downwards, as far as the *Joint* marked . . . . reacheth, according to the *ſituation* and *figure* expreſſed *Figure* A and B. But afterwards when thoſe *Leaves* are bent or preſt downwards, and that the Hand be removed again from the *Herb*, then the ſaid *Steams* do move more copiouſly out of the Earth T through the inward and wider Nerves 1 1, and the aſcending *Flappets* 3 3, than through the outward and more narrow 2 2, into the Stalk, and therefore firſt ſhut the *Flappets* that are about 5 5, and that lead from the wider and inward *Nerves*, to the outward 2 2; and proceeding further, enter into the *Muſcles* of the *Leaves b b*, and blowing them up, do ſomewhat lift up the *Leaves d d* that before were preſt down; and by this their lifting up of the *Leaves* do preſs thoſe ſteams which are in great abundance in the lower *Muſcles* of the *Leaves b b*; which being preſſed, do open in the narrow *Nerves* 2 2, the *Flappets* 4 4 that lead from the outward *Nerves* to the inward, and paſs into the broader and more inward *Nerves* 1 1; and there foraſmuch as by reaſon of the copious *exhalations* aſcending from the *Earth* T, and ſhutting the *Flappets* 5 5, which lead towards the narrow *Nerves*, they can neither deſcend, nor paſs ſideways, they are by thoſe copious *exhalations*, which continually aſcend into thoſe wider *nerves*, neceſſarily determined, to the upper *Muſcles* of the *Leaves b b*; and entring into them, together with ſteams that aſcend out of the *Earth* through the broader *Nerves*, they lift up the upper parts *b b* of the *Leaves* that are filled with theſe copious *exhalations*, but emptied with reſpect to their inward *parts c c*, and ſo reduce them to the ſame ſituation they had before, and the ſame that is expreſſed in the *Figures*.

VI. *Another Explication of the contraction of Leaves of the Senſitive Plant.*

But this contraction of the *Leaves* may alſo be aſſigned to *Cold*. For the *coldneſs* of the *Finger* repreſſeth the ſpreading motion of the *Juice* in the *Nerves*, and in a good meaſure ſtops the influence thereof; whereupon the *Fibres* do immediately contract or draw in themſelves, and at the ſame time bend the *Leaves* downwards: After the ſame manner as we find that *Cold* doth condenſe and wrinkle the *Skin* of our *Body*, whereas on the contrary, *Heat* doth extend the ſame. And the *Lappets* of the *Leaves* are drawn inwardly together, becauſe probably the upper *Fibres* of the *Nerves* are drier, and conſequently are more readily and ſooner contracted; and the lower *Fibres* ſofter, and therefore do more eaſily give way to be extended. Now that this contraction is cauſed by *Cold*, may be gathered from ſome *Flowers*, which ſhut themſelves in the night, as *Marygolds*, *Succory* and *Woodbind-Flowers*. So likewiſe we read of a *Plant*, the leaſt *ſtalk* whereof, if it be wounded with a *Knife*, immediately the *Flowers* fall from it, becauſe of the contraction or ſhrinking of the cut *Nerves* to which the *Flowers* are faſtned.

VII. *Why the* Pudefitan *Tree abhors the Breath of Man.*

Some *Hiſtorians* tell us of a *Tree* called *Pudifetana*, which cannot ſo much as endure the *breath* of *Man*.

The Reaſon of this may be, becauſe the *particles* of the *exhalation* are ſo ſtrongly driven againſt this *Plant*, that its tender *Nerves* are thereby diſſolved, and their *Texture* diſturbed. As we find that the tender *Bodies* of *Children* become ſometimes infected by the *Breath* of an *Old Woman*.

VIII. *Of a Tree in* Japan, *that hath ſympathy with Iron.*

Travellers who have viſited the Iſland of *Japan*, do make mention of a certain *Tree*, which hath ſuch a friendſhip with *Iron*, that if a Branch of it be lopt off, it may be joined and faſtned to it again, by means of a *Nail* ſtruck through it into

into the *Tree*, and flouriſh again as much as ever. Yea if the *Tree* begin to decline or wither, it preſently recovers as ſoon as *filings* of *Iron* are laid to the *Roots* of it.

Suppoſing this Relation to be true, this effect does ſeem to be attributable to nothing elſe but to the indented *particles* of *Iron*, which do open the *pores* of the *Root*, and ſo cauſe the *Alimentary Juice* to paſs up more freely into the Stem of the *Tree*. And foraſmuch as ſome of theſe *particles* do continually break forth from the *Iron* of the *Nail* that is ſtruck through the Branch, no wonder if by this means, the obſtructions are taken away, and the ready paſſage of the *Juice* be furthered.

IX. *Why Maidenhair and Cabbage cannot endure water.*

Maidenhair and *Cabbage* ſeem to abhor *water*, and to keep it off from themſelves. And therefore if they be dipt in *water* they do not grow wet, but are taken up out of the *water* as dry as when they were dipt in.

The Reaſon is, the great ſmoothneſs of their *ſurface*, which is ſuch, that it will not ſuffer any *water* to ſtick to it. For *water* cannot ſtick to any *Body*, except its ſurface have ſome ſmall roughneſs or wrinckles, wherein the *liquor* may ſtick and be intangled. Hence it is that all fat and greaſie things can admit of no *water* to ſtick to them, becauſe *Fat* hath a very ſmooth *ſurface*, and doth render thoſe things ſmooth that are beſmeared with it. Or this *quality* in *Maidenhair* and *Cabbage* whereby they reject *water*, may be attributed to a very thin *Down* that covers their *Leaves*, ſuch as we ſee there is in ſome *Fruits*, which gather all the drops of *water* upon their *points*, and keep them rounded there, ſo that they cannot penetrate any deeper, nor wet them except after a long lying in *water*.

X. *Why Water Mallows ſeem to have an Antipathy againſt Lead.*

A Man that hath dipt his hand in the *Juice* of the Root of *Water-Mallows*, *Purſlain* and Herb *Mercury*, may put it into melted *Lead*, and receive no hurt thereby.

This proceeds from the *natural coldneſs* of theſe *Juices*, and alſo from the clammy thickneſs of them, which covers the *hand* as it were with a *skin*, and hinders it from being touched by the *melted Lead*. To which may be added, that they leave alſo a great ſmoothneſs upon the *skin*, which makes the *Lead* immediately to glide from it, ſo that the heat of it hath not leiſure to penetrate the *pores* of it.

XI. *How Dittany draws any Iron Weapon out of a wound.*

So great is the *ſympathy* betwixt *Dittany* and *Iron*, that upon the touch of it *Iron Weapons* drop out of the *Wound* of any living *Creature*. According to what TULLY tells us in his 2*d* Book *de Natura Deorum*: *It is reported that the Goats in* Crete, *when they are wounded with Arrows, do ſeek for the Herb* Dittany, *which they have no ſooner taſted, but the Arrows drop out of their Bodies.*

Some have ſuppoſed this effect to be cauſed by a kind of *Magnetical Virtue* in *Dittany*, whereby it attracts *Iron*; but daily experience hath convinced this conceit of falſity. For this *Herb* when applied to *Iron*, exerts no *Magnetical Virtue* at all upon it. Conclude we therefore rather, that *Iron Weapons* drop out of the *Body* upon the eating of this *Herb*, becauſe it makes the Wound wider, and opens the Orifice by its *agitation* of the parts of it; ſo that by this means the *Iron* either drops out, or is eaſily pulled out with the leaſt touch. To which may alſo be added the force or impulſe of irritated Nature, which being aſſiſted with the *particles* of the *Herb*, or ſome Effluvia proceeding from it, doth endeavour to thruſt out that which is hurtful to it.

XII. *Wild Pennyroial is a great enemy to the Rattle-Snake.*

Thoſe that have lived in *Virginia* tell us, that a ſort of *Wild Pennyroyal* grows there, which is ſo hateful to a *Serpent* called the *Rattle-Snake*, that if the bruiſed *Leaves* be but held to the *Noſtrils* of this *Serpent* for about half an hour, it infallibly kills it. And therefore this *Snake* is never found in thoſe places where this *Herb* grows.

XIII. *There is no ſuch virtue in Plants whereby they can chaſe away Devils.*

There are no *Plants* that have the power of driving *Devils* away. For Bodily *Subſtances* cannot exert any activity upon *Spiritual* or *Immaterial Ones*. And tho' ſome *Herbs* are applied to perſons poſſeſt, in hope to yield them ſome relief, yet muſt not we conclude from thence, that they have any power againſt the *Devils* themſelves, for the reaſon above-mentioned.

CHAP. VI.

Of the Original of Plants.

I. *Whether Plants grow without Seed.*

IT is believed that ſome *Plants* grow of themſelves without *Seed*; ſuch as *Aſarabacca* which grows ſometimes upon *Walls*; and a kind of *Maidenhair* which grows on the ſides of *Wells* and near moiſt places. Beſides, many other *Herbs* which of themſelves ſprout out of the *mould* that hath been deep dug out of the *ground*.

II. *The opinion of the Cabaliſts.*

They who attribute the *virtue* of *inferiour things* to the *Stars*, and ſuppoſe that nothing can be done upon *Earth*, without the concurring help of the *Heavenly Influences*, refer the original of *Plants* to the *Sun*, or any of the other *Planets* or *Stars*, as making them the *Authors* of all *Sublunary Generations*. And therefore ſuch as theſe are of the opinion of the *Cabaliſts* who preciſely aſſert, *That there is no Herb or Plant here below, which hath not his Star in the Firmament, which ſtrikes with its Rays, and bids it grow*. But having before treated of the *power* of the *Stars*, and taken it for granted that our Modern *Philoſophers* are not ſo weak as to attribute all particular *effects* to general *Cauſes*, we muſt look out elſewhere for the Original of *Plants*.

III. *The opinion of ſome Philoſophers.*

Some are of *opinion*, that all *Plants* ſpring from the fortuitous meeting of ſome *Earthly particles*, as when the inſenſible *parts* of the *Earth* being agitated in the upper Cruſt of the *Ground* by the *ſubtil matter* do acquire ſuch a *figure*, together with ſuch a *ſituation* and *motion*, as is neceſſary for the firſt formation of the *Plant*: And from whence, as to the foundation, all the other parts afterwards are reared, whilſt the *Nutritious Juice* mounting up through this firſt Rudiment of the *Plant*, doth dilate the *parts*, and aſſigns a certain *figure* to them. They ſuppoſe indeed that the *Generation* of *Plants* is ſomewhat *Analogous* to that of *Animals*, *viz.* when *Plants* do ariſe or ſpring from a *Seed* ſown: Becauſe the *Seed* in this caſe reſembles the *Egg* of *Animals*, as conſiſting of a *Bud*, a *Shell*, *Membrans*, and a *Yolk*. Yet with this difference, that the diſtinction of *Sexes* is not requiſit to the *generation* of a *Plant*, becauſe every *Plant* gives forth its *Seed* in the *Fruit* it produceth; which *Seed* doth not ſtand in need

of

of a *Womb* to receive and cherish it, since the *Fruit* it self supplies that place. But yet for all this they suppose also that *Plants* may be *Generated* without either *Root* or *Seed*.

IV. *Herbs sometimes grow on the surface of the Sea-water.* For they observe with the *Antients*, that *Herbs* grow on the top of the *Sea*, and that these are the product or effect of the coagulated *Sliminess* of the *Water*, wherein the heat of the *Fire* is most predominant, and the *Sea* moves more slowly than in other parts of it. Yea there are some who have made it their observation more than once, that *Herbs* have sprung out of *Snow* that hath been kept a long while, which *Herbs* they have found to be of a *bitter Taste*. Neither can this be any matter of so great wonder to us, when we find that *Worms*, not much unlike those which are *generated* in our *Bodies*, are sometimes *generated* out of *Snow*, as some ingenious persons in *Germany* have lately observed.

V. *From calcin'd Earth several Plants have been produced.* Others again have observed, that *Herbs* have sprung forth from *burnt* or *calcin'd Earth*, especially after it hath been *watered* with a copious *Shower*. Because by the *power* of *Heat*, the *particles* of *Bodies* are as it were let out of their prisons, and joining variously together, do form the *Rudiments* of *Plants*; which the moisture doth further unite and work together. Now that in this *Earth* the *Seeds* of *Vegetables* lie hid, may be gathered from this, that if after it is *burnt* it be exposed to the *Air* and *Rain* again, it brings forth divers *Vegetables*.

VI. *By what means a Wood could spring up without the sowing of any Seeds.* *Historians* tell us, that a great *Wood* sprung up out of the *ground* in *Cyrene*, after the falling of great and copious *Showers*, which extended it self to many miles. And THEOPHRASTUS *Histor. Lib. 6. Cap. 3.* says that a famous *Tree* called *Laser* (which PLINY reckons amongst one of the excellent gifts of *Nature*, as being of great use in many *Medicinal Compositions*, and strengthning concoction in *Old Men* and *Women*) sprang out of the *Earth* in those parts, after a shower of *Rain*, whereas before it had been there altogether unknown.

Some imagine that this great *Wood* and useful *Tree* did not spontaneosly, or of themselves spring out of the *ground*, but from *Seeds* carried thither by the *Winds*. But they suppose there is no necessity to grant this, forasmuch as THEOPHRASTUS tells us, that the ground in *Crete* can scarcely be turn'd up, but that *Cypress Trees* do spring up from it, and this not from any foreign *Seeds* conveyed thither, but because the ground there abounds with *particles*, which, when exposed to the *Air* and agitation of the *Sun Beams*, do form the *Rudiments* of those *Trees*. And the reason, say they, why the same doth not happen in other ground, is because the *particles* of *Seed*, cannot be so mingled and grow together, as is necessary to form the first organization of those *Plants*. For it is a thing notorious beyond all dispute, that every *ground* is not proper to bring forth all manner of *Plants*; for we see that those *Plants* which grow in great abundance in both the *Indies*, *Brasile*, *Arabia*, &c. will not grow in *England* or *Flanders*, or other northern parts of the *World*. Yea in one and the same *Country* some *Plants* grow in one part, and not in the other of it, according to the peculiar quality and disposition of the *ground*. So that they suppose that *Woods* may be generated, not only by the *Industry* of *Man*, or by *Seeds* carried by the *Winds*, but from *particles* found in the *ground*, which by *heat* may be so disposed, as to shoot up into different *Plants*.

Wherefore it cannot seem strange that on the Dikes that are cast up in the *Isle of Ely* for the draining of the *Fenny Grounds* such vast quantities of *Mustard Seed* should grow, tho' never any known in the memory of men to have grown there before. So likewise after the Dreadful *Fire* of *London* great quantities of the *Narrow Leav'd Neapolitan Hedge-Mustard* was known to grow in the *Ruins* of this *City*, according to the relation of many Credible *Authors*, whereas for many hundreds of years the ground had been built with *Houses*, nor ever any such *Herb* was known to grow there, so that it must be concluded, that either this *Herb* did grow of it self there, or that it grew up from *Seeds* that had so long been hid in the ground, which none will easily admit.

VII. *Hedg Mustard grows without Seed.*

But all difficulty will be removed as to this point, if we consider how *Plants* grow upon *Walls*, *the tops of Houses* and *Rocks*: To which places it is not easie to be conceived how any *Seeds* should be conveyed; and therefore it seems most obvious to conclude, that they proceed from large and plentiful *Showers*, which leave some slimy matter upon the said *Walls* and *Rocks*, which being cherished and assisted by the *Suns Prolifick Heat* doth bring forth *Herbs*. It cannot be doubted, but that many *particles* of the *Earth* do mingle themselves with the *Steams* that do continually ascend from it; which afterwards when the said *steams* or *vapors* are turned into *Rain*, fall down again, and cleave to rough *Bodies*, and when the water is again rarefied into *vapor*, do remain behind upon the said *Bodies* in the form of *Slime* or *Mud*, out of which afterwards many *Plants* do bud.

VIII. *How Plants grow upon the tops of Houses and Rocks.*

But notwithstanding all these *Reasons* and *Experiments*, our modern *Philosophers* believe that all *Vegetables* are formally contained in their *Seeds*, and that they are not formed by apposition of *parts* as *Stones* and *Metals* are, but at once and all together like perfect *Animals*. They cannot imagin how the fortuitous concourse of divers *particles* can form that vast number of *similar parts* as well as *organical*, which enter the composition of every *Plant*. Neither can they any more conceive how the *pores* of the *grain* of *Seed* that is cast into the *ground* should be so disposed, as that the *Juices* which penetrate them, should of themselves range themselves into that order, wherein consists the form of each *Plant*. Wherefore they conclude that all *Plants* were formed together and at once, and that they are so compriſed one in another, that the latter are only an uncasing or unfolding of that which was contained in the first *Plants*.

IX. *All Plants proceed from Seeds.*

X. *This confirmed by the instance of a Bean.* Accordingly we see that a *Bean* contains formally the *Root*, *Stalks* and *Leaves* of the other *Bean* that is to grow from it; which therefore makes it probable that this 2*d* *Bean* does again contain a 3*d*, and this 3*d* a 4*th*, and so on to an infinity. So that we are to consider the growing of *Plants* only as a repetition of *Generations* performed every year, by the production of new *Leaves*, *Flowers* and *Fruits*, whose *Branches* actually contain an infinity of others; and to conceive that of all the *Leaves*, *Flowers* and *Fruits* that are actually formed in the *Branches*, there be only

only a certain number that can be unfolded every year.

XI. *Malpighius's Experiment to this purpose.* MALPIGHIUS designing to make a trial whether *Earth*, without being sown with any *Seed*, could bring forth *Herbs of it self*, put some *Earth* which had been dug deep out of the *ground* into a *Glass Vessel*, and bound over it a manifold doubled piece of *Silk*, so as that the *Air* and *Water* might pass through it to the *Mould*, and yet keep off those small *Seeds* that are carried up and down in the *Air*; but he could never find that any *Herb* ever sprouted in the said *Glass*.

XII. *God is the Author of the first Plant of every Species or Kind.* So that we must conclude that the *first Plant* of every kind was at the beginning produced by *God*, when he divided the *matter* of the *World* into parts of that exact *bigness* and *figure*, as they were to be in order to their compoling the *Buds* of each kind of *Plants*. But not that they were produced according to the before-mentioned opinion of some *Philosophers*, from the fortuitous concourse of many *principles*, which so united themselves together, as to form such a *Plant*; for if this were so, we should see sometimes *Plants* of new kinds produced, which never hapning, we must conclude, that *God* is the Author of the first *Plants* of each kind.

XIII. *The cutting or lopping of Plants conduceth to the conservation of them.* *Plants* that are frequently cut, cropt or lopt, do grow the better, and live so much the longer.

The Reason is, because frequent *Amputation* doth renew the *Juice* of the *Plant*, by keeping it from spending it self too much in luxuriant and supernumerary *Branches*. So that *Plants* that are wont to live one year only, if they be not cut in time, when they are duly cropt, will outlive that time; such as *Lettice*, *Purslain*, *Cucumbers* and the like. And as to *Trees*, we find that such as are not used to be lopt, do never attain to the tallness of other *Trees* of the same kind, on which *Amputation* is celebrated.

XIV. *Why Plants growing in different places, are endued with different properties.* *Plants* that grow in the *Philippine Islands* are indued with different *qualities*, and as they are *planted* or grow towards several *quarters* of the *World*, they are accordingly indued with various *affections*. For those *Leaves* which grow towards the *East* are good and healthful; whereas those which grow towards the *West* are poisonous and deleterious. So with us, those *Apples* that grow near those places where there is great store of *Cabbage*, yield a strong and stinking *smell*.

The Reason is, because some *Effluvia* do exhale either from the *Earth*, or some neighbouring *Plants*, which impart some noxious qualities to the *Leaves* and *Fruits* of the said *Trees* or *Plants*. For it is notorious, that poisonful *Trees* or *Herbs* do communicate their venom to *Bodies* that grow near them. Because the ascending *vapors* carry always somewhat of the same *Earth* along with them, from whence they ascend; and young and tender *Plants* that grow near to stinking or noxious, are easily affected and infected by them.

XV. *Plants are endued with the qualities of the Nutriment they take in.* Thus we see that the *Wine* that is made of the *Grapes* of a *Vine* that hath had *White Hellebor* or *Herb Mercury* grow near it, becomes *purgative*: And in like manner, that the *Fruits* of any *Tree* become *Narcotick*, *Venomous*, *Diuretick*, &c. if their *Roots* be moistned with such like *Juices*. Wherefore to make *Plumbs purgative*, it is a common thing to bore several *holes* in the *Trunk* of the *Trees*, and put into them the *Juice* of *Hellebor* or *Colloquintida*, by which means their qualities are imparted to the *Tree*.

It is a matter of common Experience, for *Plants* to grow wild, and degenerate from what they were. Thus a *Fig-tree* degenerates into the *Wild Fig-tree*, *Barley* into *Oats*; besides many other such like *Transmutations*.

XVI. *What is the reason of the degenerating of Plants.* This degenerating of *Plants* proceeds either from the negligence of the *Husbandman*, the situation of the *place*, or the quantity of the Ambient *Air*. For *Plants* grow wild, except they be set in places that are fit and suitable to them, and that they be so cultivated as their Nature doth require. Which tho' it is evident in many *Plants*, yet in none more than in *Violets* set or sown for encrease, which if they be not every 3 years transplanted, do degenerate into a pitiful *Flower* without any scent at all.

The Reason of which deficiency is, because the *Rudiments* of *Plants* in their first original do require a certain determinate matter, out of which their texture and disposition of *Plants* must be produced. And forasmuch as such *matter* is not to be met with in all *places*, where the *Seed* is sown, it is no wonder if the *Plants* in such ground do degenerate and become changed into others. For this change is not made in the *Root*, but in the *Seed* it self, whilst it doth not find convenient and suitable matter, or when by reason of old age, having lost its *vigor*, it must necessarily change its nature. Hence skilful *Gardners* are wont to make trial of the goodness of their *Seeds* by putting them into *boiling water*, which if they be lively and vigorous, will in an hours time begin to sprout.

XVII. *Why the quarter of Heaven to which the parts of a Plant were directed, is to be observed in the transplating of them.* Amongst the *Rules* that are given by the *Antients* for the setting of *Plants*, this is one; that care be had that the *Plants* removed from one place to another, be set so, as that their parts may answer to the same quarters of *Heaven*, as they did in their former station.

The Reason is, because when the aspect of *Trees* is changed from one quarter of the *Heaven* to another, the inward *disposition* of the parts is changed together with it, and the passages whereby the nourishment is conveyed, are altered, and acquire another situation. For if any will make the Experiment by cutting the *stem* of a *Tree* grown in an open *Field*, with a *Sithe*, he will perceive several *Circles* that are broader towards the *South*, and narrower towards the *North*. Which cannot be adscribed to any other cause, but to the *Heat*, which proceeding more copiously from the *South*, doth more strongly agitate the *particles* of the *Tree*, and more extends the Veins of it, than that warmth which comes from the *North*. And tho' this difference be not to be found in *Brazile-wood*, all the Circles whereof are Concentrical, and at an equal distance from each other, the Reason is, because in the *Torrid Zone* Trees receive an equal degree of heat from the *North*, as from the *South*. Hence it is that from the position of these *Circles* some have taught how to find out the *Meridian*: And the more skilful *Gardners* and *Husbandmen* enjoin transplanted Trees to be set with the same respect to the quarter of *Heaven*, which they had in their former position.

CHAP.

CHAP. VII.

Of the Nouriſhment of Plants.

I. *How the Root grows and is encreaſed.*

AS ſoon as that part of the *Sprout* which is to conſtitute the *Root*, is become ſuch, we perceive preſently that it is nouriſhed and encreaſed as to all *dimenſions*, that is, in *Length*, *Breadth* and *Depth*.

The Reaſon is, becauſe the *Juice* of the *Earth* paſſing through the thin *Skin*, doth ſome part of it enter into the *Bark*, and in part alſo into the *Woody Fibres*. Now that which enters into the *Fibres*, doth by little and little mount upwards, as well by reaſon of the agitation it hath received from the *Sun*, or from ſome *Fermentation*, as from the *circular motion* of the *Earth*; according to which every Body that is ſo moved, ſtrives to withdraw from the Center of its Motion. Now proportionably as this new *Juice* mounts upwards, it muſt of neceſſity paſs from the *Woody Fibres* into the *Bladders*, where meeting with the old *Juice*, it by commixtion therewith produceth a *Fermentation*; from which, as from all other *Fermentations* in *Chymiſtry*, certain *concretions* are produced, which at the ſame time do encreaſe the dimenſions of the *Bladders* and of the *Woody Fibres*.

II. *Dunging of the grounds conduceth much to their bearing or fruitfulneſs*

To the end that *ground* may be the more fit to bear *Plants*, it is *dunged* before the great *Rains* begin to fall. For the Barrenneſs of *Vines*, *Wheat* and other *Corn* is overcome by *Stercoration*.

The Reaſon is, becauſe *Dung* abounds with *Salt*, which being diſperſt through the Pores of the *Earth* doth allay the moiſture and coldneſs of it, and promotes growth or *germination*. For the life of *Plants* conſiſts in *heat* and *moiſture*, whereof the one is the *Agent*, and the other the *Patient*; yet ſometimes it may ſo happen, that *dunging* of ground may do more hurt than good, *viz.* when there is no moiſture to rot the *Dung*, and diſſolve the *ſaline parts* of it. Hence it is common with *Husbandmen* to *dung* their *grounds* at ſuch a ſeaſon, when they have reaſon to expect there will be copious *Rains* to dilute it, as before the beginning of *Spring*, or towards the latter end of *Autumn*, to the end that the moiſture having diſſolved the *Salt* that is in the *Dung*, it may be conveyed by this vehicle of the water to the inmoſt *pores* of the *Roots*. For otherwiſe the *Corn* that is ſown will be in danger of being burnt by heat, in caſe the *Salt* be not diſſolved, or that the ſurface of the *ground* be overmuch cumbred with abundance of *Dung*. And therefore it is PLINY's obſervation, *Lib.* 18. *That Fields, if they be not dunged, are too chill and cold; and when over dunged, are burnt up.* For there is a great difference between the *dungs* of ſeveral *Animals*; for Pigeons *Dung* is the hotteſt of all, and next to it Sheeps *Dung*, which two are only proper to recover thoſe *grounds* that are chil'd with over-much *cold* and *crudity*. Hogs *Dung* is of a ſharp and biting nature, ſuch as is found in *Onions*. But the *Dungs* that are more moderate, and of a middle nature between theſe, are Horſe *Dung*, Aſſes *Dung* and Cow *Dung*.

III. *Dung conduceth to the encreaſe of Plants.*

By this means the *life* of languiſhing, and almoſt dead and withered *Trees* is recovered and reſtored, *viz.* by laying *Dung* to the *Roots* of them. Hence the *Grain* called *Panick*; which is ſo called from the *Paniculæ* or *Beards* it is armed with, if it be laid to the lower part of the *Root*; it is known to be of good uſe to promote the growth of the *Tree*: For being of a clammy and ſpungy *ſubſtance*, it ſucks in the moiſture of the *Earth*, and ſo furniſhing the Root with copious nouriſhment, it dilates and makes it grow.

IV. *The ſtones of Grapes promote the nouriſhing and encreaſe of vines.*

In like manner ſome tell us, that the *Stones of Grapes*, laid in great quantities to the *Roots* of *Vines*, do greatly conduce to their *thriving* and *encreaſe*: Becauſe theſe *Stones* are furniſht with *pores* ſuitable to admit the *Juice*, which ſerves for *nouriſhment* to *Vines*, which after they have ſuckt good ſtore of the ſaid *Juice*, communicate the ſame to the *Roots* of the *Vine*.

V. *Why Fields that have lain fallow, are more fruitful than ſuch as are continually ſown.*

Fallow Grounds, that is, ſuch as are only *tilled* every other *year*, are more *fruitful* than ſuch as are ſown continually; and are the more fruitful, the longer they have been ſuffered to lie *fallow*, eſpecially without ſoiling.

The Reaſon is, becauſe by *tilling*, the *pores* of the *Earth* are opened, by which, as through ſo many, on purpoſe prepared *paſſages*, the *Juice* is carried upwards into the *Air*. Whereas in *fallow grounds*, the ſaid *pores* are ſhut up, and there is no way for the *ſteams* to eſcape. And for the ſame reaſon it is, that *Husbandmen* burn the *ſurface* of the *Earth*, becauſe when the *Stubble* is burnt after that the *ground* hath been reaped, the *watry parts* fly away, and the ſolid *ſubſtance* that remains is diſſolved by the moiſture of the *Earth*, which by its thickneſs promotes the *fruitfulneſs* of the *ground*. And therefore VIRGIL tells us in the Firſt Book of his *Georgicks*,

From burning Barren Fields, oft plenty comes,
When brittle Stubble crackling Fire conſumes;
Whether from this, new force and nouriſhment
The Earth receives; or elſe all Venom ſpent
By Fire, and forth ſuperfluous moiſture ſweats.

VI. *Why Herbs grow better in a level Field than on hanging ground.*

A *Level Field* is more proper to nouriſh *Herbs* and *Plants*, than a *hanging ground*; for it is obſerved, that thoſe which grow in this latter do very ſeldom arrive at their due magnitude.

For ſeeing that *Salt* doth greatly conduce to the *nouriſhment* of *Plants*, the ſame is eaſily diſſolved in a *hanging ground*, upon the falling of *Rain*, and is carried downward, without any, or very little profit to the *ground*. Whereas a *plain* or *level ground*, beſides that it keeps all the *Salt* that is laid upon it, for to improve it, receives the fatneſs which is conveyed to it, together with *Rain* from other *places*. Hence it is that ſome aſſure us, that *Sea-weed* being laid to the *Roots* of *Cabbage*, do promote their growth, which can be adſcribed to nothing elſe, but to the *Salt* which abounds in the ſaid *Sea-weed*, and therefore imparts *fruitfulneſs* to the ground.

VII. *Cucumbers are made tender by ſteeping their Seeds in Milk.*

Cucumbers become tender and delicious by ſteeping their *Seeds* in *Milk* before that they be ſown. The Experiment might very probably be of uſe if applied to the *Seeds* of *Artichocks* and other *Plants*, for the taking away of their harſhneſs and bitterneſs.

The cauſe of this change may be, that upon the ſteeping of the *Seeds* in *Milk*, the *Fibres* which

are formed in the *Roots*, take upon them such a *Figure*, and such *Texture*, as to give way only to such *particles* which constitute *sweetness*, and to reject all other thicker *Juices*. Whence it is that those who endeavour to advance the smell of *Flowers*, and exhale it by *Art*, order the *Rose-trees* to be planted near *Garlick*, which draws to it self all the nasty stinking *Juices* of the place, leaving the *sweeter* and more refined to serve for nourishment to the *Rose-tree*.

VIII. *The steeping of Seeds cannot prejudice the goodness of the Plant or Tree that comes from it.*

Neither need we to fear lest the *steeping* of *Seeds* should be any prejudice to the goodness of the *Fruit* by over-hastning its *Ripeness*; since that always depends upon the vigor and virtue of the *Seed*, which the hasty or slow *ripening* of it are not able to change. And therefore this *Experiment* may be extended to all *Grains*, *Seeds*, *Stones*, *Kernels*, *Roots*, or any other things that are committed to the *ground*.

IX. *Why some Plants grow more swiftly, others more slowly.*

Some *Plants* grow more slowly, or swiftly than others: For *Willows*, *Vines*, *Gourds*, &c. encrease much in a very short space of time, and more especially *Gourds*, which grow to that bigness, that according to PLINY's relation, they *can scarcely be carried*. Whereas on the contrary, the *Oak*, *Medlar*, and other such like, admit of very slow *encreases*.

The Reason of this difference is, because the *nourishment* of *Plants* depends on their *Juice*, which from the *Roots* is driven through the *pores*, as through so many little *veins*, which it fills to that degree, that they swell big with it, and are not able to contain all the *particles* of it. And forasmuch as the sides of the *pores* are too hard to be extended by the *Aliment*, therefore it is that their encrease also is very slow, and sometimes that they altogether cease from growing, according as it happens to *Old Trees*, which receive no encrease from the *matter* that comes to them, but continue at a stand. But *soft Bodies*, having pliant *pores*, and such as are easily penetrable, it is no wonder if the *Plants* that are so qualified are of swift and great encrease. Hence it is that *Gourds* grow to that vast bulk in the *East Indies*, that as SCALIGER saith, some of them are of 13 *Palms* breadth, and such as a Porter is not able to carry.

X. *The South Wind favours the growth of Plants.*

Plants are very vigorous when a *South Wind blows*, and advance more in growth than when other *Winds* bear sway.

For seeing that the *South Wind* is warm, and brings many hot *Exhalations* along with it from the *Torrid Zone*, it readily opens the *pores* of the *Plants*, and causeth the *nourishment* to mount up more copiously out of the *ground*, and to be distributed through all their parts.

XI. *Why Plants do not grow in the* Winter.

On the contrary, *Trees* do not grow in the *Winter*, because the coldness of the *Season* fixeth and congeals the *Juices* in the *pores* of the *Earth*, and consequently deprives the *Trees* of their *nourishment*.

XII. *Some Trees are set towards the Meridian.*

Those *Trees* which delight in the warm *Sun*, such as the *Plumb Tree*, the *Fig Tree*, the *Vine*, the *Apricock*, and such like, are commonly set upon a *Bank* or *Wall*, facing the *South Sun*.

The Reason is, because a double convenience accrues to these *Trees* from this position or situation: The *first* is, that the warmth of the *Wall* caused by the reflexion of the *Beams* of the *South Sun*, doth greatly cherish and promote the growth and fruitfulness of these *Trees*. The 2*d* is, that they keep off the shade: For when *Trees* grow round, that is, with their *Branches* spreading circularly, the upper *Branches* do shade the lower, but being spread against a *Wall*, this inconvenience is prevented.

XIII. *Water is turned into the substance of Plants.*

The Famous VAN HELMONT put 200 pounds of *Earth*, dried in an *Oven*, into an *Earthen Pot*, and set in it the stem of a *Willow* of about 15 pound weight. After the time of 5 *years* he took up the *Willow*, and found it to weigh 165 pound, whereas the weight of the *Earth* was not above two ounces diminished, and had only been watered with *Rain-water*. And in another place of his *Writings* he tells us, that many *Fishes* live upon *water* alone, and particularly supposeth the *Salmons* to do so.

This encrease does not proceed only from the *substance* of the *water*, but from the *Nitrous* and *Aerial Ferment*, which furnisheth *Plants* and other *Bodies* with their *nourishment*. For whenever a *Plant* wants this, it becomes altogether *unfruitful*. For we must not suppose that *water* is a simple *Body*, but consisting of many *Heterogeneous particles*, as may be easily proved from this, that *water* is subject to *putrefaction*, which it could not be in case it were simple, and devoid of all composition.

XIV. *How Fruits become meliorated by graffing.*

If an incision be made in a *Wild Tree*, and a *Graff* taken from a set *Tree* be *Ingraffed* into it, by this means the *Fruit* is meliorated, and of wild and harsh, becomes mild and delicious. And the same happens also, if the *Scion* be taken out of the same *Tree*, into which it is afterwards *Graffed*.

The Reason of this seems to be, because the *Fibres* of the *Ingraffed Scion* do not so perfectly correspond with the *Fibres* of the *Tree*; and the *Juice* which passeth *from the latter*, cannot freely enter into the former; because the ranging of the *pores* is changed, and so other ways must be prepared for the conveying of the *alimentitious matter*: So that by this means the *Aliment*, as it were, undergoes a 2*d* digestion in another *Stomach*, and the occurring *Juices* are wrought or elaborated after a new manner. Hence it is that the *Fruit* growing upon a *Garden Scion*, *graffed* on a *Wild Tree*, becomes meliorated; because the *Alimental Juice*, which ascends through the *parts* of the *Plant*, having been already digested in the first *Stomach*, is sent into the second to pass through a second *Concoction*. And if any body will take the pains to multiply the said *incisions*, and *graff* a second or a third *Scion* upon the first, he will find that by every *insertion* the *Fruit* will attain a higher degree of melioration, because the *Alimentary Matter*, passing through so many different *Strainers*, is the more exactly prepared, and higher exalted and purified. An *Example* whereof we have in the History of CORELLIUS a *Roman* Knight, who, when he at his *Country House*, near *Naples*, ingraffed upon a *Chestnut Tree* a *Scion*, taken from its own stock, it brought forth a *Chestnut*, much exceeding the common in goodness, and which afterwards were called from his name *Corellianæ* or *Corellian*; and when afterwards a *Freeman*, whom he had made his *Heir*, had *Ingraffed* the same a second time, it did not bring forth *Chest-*

nuts

nuts in that plenty as before, but much better than the *Corellian*.

XV. *A Branch cut off from a Graff, doth not bring forth so good fruit as the Graff it self.*

But the contrary happens when we cut off a *Branch* or *Twig* from a *Graffed Tree*, and put it into the *ground*.

The Reason is, because this Branch being put in the *ground*, and taking *Root* there, doth draw all its *nourishment* from thence only, which is prepared by one continual *percolation* or straining: And for this Reason brings forth less and worse *Fruits* than the *graffed Tree* whence it was taken; because in it there is a double concoction of the *Alimental Juice*, *viz.* in the *Stem* or *Stock* into which the *Scion* is *graffed*, and in the *Scion* it self; whereas in the Branch cut off from the *graff*, there is but one digestion or preparation of the *Aliment*.

CHAP. VIII.

Of the Germination, Sprouting or Budding of Vegetables.

I. *How Germination is performed.*

THE *Germination* of *Vegetables* is that whereby the *Bark*, *Leaves* or *Branches* do send forth *Buds*, *Fruits* and *Seeds*, by a propagation of their *Fibres*. And so in a like manner a *Seed* is said to *Germinate* or *Sprout*, when the outward shell of the *Seed* is burst open by the breaking out of the *Bud* which appears above ground.

II. *Why Plants send forth their buds upwards.*

It is natural to all *Vegetables* to send forth their Buds *upwards*, tho' they be sown in a *hanging ground*; whereas on the contrary, the *Roots* of *Plants* tend downwards, and are but seldom seen on the surface of the *Earth*.

It will not be difficult to give a reason of this, if we consider how the *Germination* or *Sprouting* of *Vegetables* is performed, and by what means the *Seminal Virtue* presseth through the *surface* of the *ground*. For seeing that *Germination* is nothing else but a kind of *Dilatation* of a *Plant*, caused by the entrance of the *Juice*, which makes it swell, distend it self, and to sprout or break forth upwards: And forasmuch as no Expansion can be without *heat*, it is evident that the *Bud* which breaks forth from a *Plant*, doth proceed from *heat*, by the impulse whereof it is also carried upwards. For the nature of *heat* is always to mount upwards, and to drive all the *Bodies* it meets with, that way. And the reason is the same with regard to those *Vegetables* which grow on a *downhill*: For as *fire* that is kindled in a shelving or hanging place, doth not follow the declination or declivity of the *place*, but mounts up directly: So *Plants* that *grow* on the sides of *Hills*, do always tend upwards, as being directed and carried by the *heat* which always keeps that course. True it is, that for the same reason it seems that the Root also ought to mount upwards, forasmuch as it is likewise dilated by heat, and so it would without doubt, but that it is swayed downwards by its *Aliment* which is in the *Earth*, to which it tends. For as the *flame* of a *Torch* doth insensibly sink downwards, to feed upon the *Wax*, and to carry up the same to the upper parts: So the *heat* which is contained within the *Roots*, tends to the lower parts of them, where it draws in that *nourishment*, which it afterwards sends up to the *Stem*, *Branches* and *Leaves*, for their support and growth.

III. *Why moist and watry Fruits are ripe soonest.*

Watry and *moist Fruits*, as *Pease*, *Cherries*, *Gooseberries*, *Currans* and *Strawberries* are the first that are *Ripe*.

The reason is, because the *watry Juices* are always the first that mount upwards, forasmuch as their smooth and even *figures* make it easie for them to separate themselves from others: Seeing therefore that *Pease*, *Cherries*, &c. contain more of this *watery Juice*, and are more nourished by it, therefore they must needs be *ripe* before other *Fruit*.

IV. *Why Oniens sprout and grow tho' they be not set in the ground.*

All *Vegetables* that have *round* or *bulbous Roots*, that is, such as consist of *Coats* or coverings one above another, as *Onions*, *Aloes*, *Herb Pennyworth*, *Saffron*, *Squills*, *Leeks*, &c. do shoot and grow, tho' they be taken out of the *ground*, and hung up in the Air within doors.

The Reason is, because *bulbous Plants* do not suck their *Aliment* out of the *Earth* by the *strings* of their *Roots*, as other *Vegetables* do; but draw it in from above, *viz.* that *Juice* which lies hid in their *Bodies*, and those thick *Coats* wherewith they are covered; whence it comes to pass, that these *Roots*, being filled with *moisture*, and containing much *alimentitious humours* within their *Membrans*, whensoever the same is excited by *heat*, they begin to shoot forth. And that this is so, daily experience teacheth; for when *bulbous Plants* grow, their *Roots* are sensibly diminished, because the *Juice*, which swell'd them up before, becomes by degrees exhausted, and turns into *Stalk* and *Seeds*; as it is evident in *Pennyroyal* and *Orpin*, wherewith some Country People adorn their *Chimneys*, by tying them to little *Lathes*, on which they grow and continue green for a great while. But most of all is this visible in *Housleek*, which will bring forth *Leaves* and *Branches* 2 or 3 years together, if its *Root* be only wrapt up in a Linnen Rag dipt in *Oyl*, and be renewed every half year.

V. *Why some Leaves of the* American *Aloes fall off, and others grow in the stead of them.*

It is observed concerning the *American Aloes*, with indented or saw-like *Leaves*, that every *year* some of its *Leaves* do wither, and as many grow in the stead of them, tho' it be not sprinkled with *Oyl*, but only wrapt up in a *Red Cloath*, and so hung up in a *Kitchin*.

The Reason is, because the *alimentary Juice* in this *Plant* does continually circulate from the *Root* to the *Leaves*, and from them again to the *Root*. For how else could it be, that the *Root* continuing undiminished, so much *nourishment* should be furnished for the production of new *Leaves*, except the said *Juice* were continually pusht forwards from the withered *Leaves* to the *Root*, in order to a new *Production*?

VI. *How a Rose may be made to bud about* November.

If the top of a *Rose-tree*, presently after its *budding* be cut off, it will *bud*, and bring forth *Roses* again, about the month of *November* following. Which sprouting doth not proceed exactly from the top that hath been cut, but from the *shoots* or *twigs* that grow near it.

The Reason is, because the *Juice* which is contained within the *Plant*, which otherwise would have gon to nourish the top of it, upon the cutting of it off, is conveyed to the *Sprigs* that grow about it, and from them produces *Roses* of a late growth.

growth. And the same effect will be produced if you pluck the *Buds* of a *Rose*, as soon as they are first *knotted*. Yet it is probable that the *budding* of *Rose-trees* may be retarded, by tying a *Packthred*, or other *Cord* very strait about the *Rose-tree*, because this ligature, will hinder the *Juice* from mounting so soon, as otherways it would.

e's, ..nd other such like Trees, do only send forth Branches at their tops.

Some *Trees* have only *Branches* proceeding from the tops of them, as the *Fir*, *Pitch-tree*, *Cypress-tree* and *Cedar*; whereas others shoot forth *Branches* from all parts of them.

The Reason of this different *Germination* of *Trees* is from the *pores*, by which the *Alimental Juice* passeth from the *Root* to the *Branches*; for if they be strait and perpendicular, the *Juice* is carried up along through them to the top, where the *Juice*, by reason of the great abundance of it, is forced to break forth, and to spread it self into *Branches*. To which also may be added, that the *Juice* which ascends in these *Trees* is *fat and clammy*. Whereas the *pores* of those *Trees* whose *Branches* proceed from all parts of their *Stems*, are more crooked and winding, by which means the *Juice* ever and anon breaks forth sideways. Or likewise, because their *Juice* is not so ropy and glewy, as it is in *resiniferous* or *rosin* bearing *Trees*: Wherefore as a great *Fire* or *Flame* which passeth up through a *Pipe*, with holes on the side of it like a *Recorder*, doth continually pass some of its parts through the said side holes: So the *Juice* in *Trees* being carried up through the *pores*, breaks forth by all the ways it finds open for it, and more especially through the tender *shoots*, the softness and tenderness whereof afford it a more easie passage.

VIII. *Why the Leaves of some Trees are always green.*

The *Leaves* of some *Trees* and *Plants* are always green, as the *Bay-tree*, the *Laurel*, *Cypress*, *Ivy*, *Fir*, *Box*, *Rosemary*, &c. whereas others towards the end of *Autumn* lose their *greeness*, and are spoiled of the Ornament of their *Leaves*.

The Reason of the perpetual *verdure* of some *Trees* and *Plants* is, because their *Leaves* consist of a more solid *matter*, and do abound with such hot *Juices*, that the *pores* through which they run, cannot be shut up by the cold of the *Air*. And for this reason it is, that in *Brazile* all the Trees enjoy this priviledge: And that in *Egypt* about *Memphis*, according to the account THEOPHRASTUS gives us, the very *Vines* and *Fig-trees* themselves never shed their *Leaves*, whereas others do lose their *Leaves*, and continue without them all the *Winter*, because their *Leaves* are more soft and tender, and therefore cannot resist the rigor of the *cold*, which contracts and draws their *pores* together, and by this means hinders sufficient *Aliment* from being conveyed from the *Roots* to the *Leaves*, which for want thereof, wither and fall to the ground.

IX. *Why tender Shoots are not fit to be grafted.*

Soft and *tender Shoots* or *Twigs*, and whose sides are not yet sufficiently hardned, are not fit to make *Graffs* of.

The Reason is, because in *Graffing* the *Fibres* of the *Scion* must be suited with those of the *Stock*, that the *nourishment* which comes from the *Root*, may have its free passage to both. For their *Orifices* must so answer one another, that the nourishment may pass from the *fibres* of the *Stalk* into those of the *Scion*. Now very *soft* and tender *twigs*, because of the tender *texture* of their *fibres*, are so bound up and straitned between their Rinds, that they cannot readily take in their *Aliment*, and therefore thrive but badly, or wither within a short time. For the *twig* that is to be *graffed*, must be of a *years growth*, to the end it may the better cleave to, and unite with the *Stock*. Thus on the contrary dry *twigs*, or which by reason of their Age or sapless, are also unfit for *graffing*, because they want *moisture*, by means whereof both their *Fibres* might be joined together, and become one *Plant*. As we see that dry and thirsty ground is Barren, and scarce able to quicken the *Seeds* that are committed to it.

X. *Why ripe Fruits fall from the Trees.*

Fruits when they are fully *ripe*, drop down from the *Trees* of themselves, and fall upon the ground.

The Reason is, because at that time, the *lateral fibres* of the *Fruits* do swell, and are no longer able to contain their *Aliment*; by which means it comes to pass, that that part of it which was used to ascend to the upper parts, finding no passage, runs *downwards* again, leaving the *Stalk* by which it was fastned to the *Tree* dry and sapless. Hence it is that some *Fruits* fall down with their *stalks*, as *Apples*, *Pears*, &c. others without them, as *Plumbs*, *Apricocks*, *Peaches*, &c. according as the *Alimentary Matter* fails nearer to, or farther from the *Fruit*.

XI. *Whence it is that Stags Horns fall every year.*

But the Reason why *Stags* cast their *Horns* every *year*, at a set *season*, doth not proceed, as some suppose, from the same cause now produced, but indeed from a quite contrary, *viz.* from an over-great abundance of a *volatile saline Juice*, wherewith *Stags* are filled at that time. For this matter continually flowing from all the parts of the *Body* of that *Animal*, and pusht upwards towards the *Head*, thrusts the old *Horns* out of their places; and being afterwards condensed by meeting with the cold *Air*, becomes turned into new *Horns*, and such as are more tender.

CHAP. IX.

Of the Decay and Death of Vegetables.

I. *Why Plants dye when they are pluckt up out of the ground.*

Plants pluckt up out of the *Ground* do wither; and tho' *Trees* that are cut down in the *Spring*, do seem to *bud* and *grow*, as long as they are suffered to lie upon the ground, yet they are no sooner taken from thence, but they by degrees *wither* and *dye*.

Plants pluckt out of the *ground* do not wither immediately, because the *Juice* doth not all on a suddain cease from flowing, neither are the *pores* so soon changed, but that the *Aliment* is still for some short time carried to their utmost *Fibres*. For *Vegetables* never die, till their *Juice* stagnates, and is no longer heated and agitated by the *subtil matter*. For upon the failing of *heat* all *motion* ceaseth, and consequently all *Germination* and *Nutrition* also, wherein the *Life* of *Plants* doth consist. And therefore *Plants* in the *Winter* season cannot properly be said to be *dead*; because, tho' they produce nothing, and there appears no sensible transmission of the *Alimental Juice*, yet it cannot be denied, but that it is still in them, because the self same *dispositions* remain in them, that are found in *Living Bodies*, and that their condition

tion is very different from those *Bodies* that are *withered* and *dead*.

II. *How it comes to pass that the Rose of Jerusalem, after it is withered, grows green and flourisheth again.*

Moreover, it happens sometimes that the parts of *Plants*, as their *Leaves*, *Sprigs*, &c. which have been shrivel'd and contracted by *drought*, are again, by the return of their *Juice* and *Moisture*, distended and displayed, as is evident in the *Beards* of *Oats*, and in the *Plant* called the *Rose of Jerusalem*; the *Root* whereof, when dry and withered, if it be put into luke warm *water*, immediately distends it self, and displays its *Sprigs*, and this by means of the *moisture* which insinuates it self into the *pores* of the said *Sprigs*, and so swells and extends them.

III. *The Juice circulates through the whole Body of the Plant*

For it can no longer be questioned, but that the *Juice* hath its course or circulation in *Plants*, like as the *Blood* in *Animals*, as may be perceived more especially in *Lettice*, *Bastard Saffron* and the *Greater Celandine*, in which *Plants* the *Juice* never rests, but as soon as their outward *Rind* is taken away, runs forth continually as the *Blood* doth out of *Animals* when a *Vein* is opened. Besides, the *Juice* of *Plants* is not found in them dispersed every where throughout their *Bodies* without any *Vessels* to contain it, seeing that *pipes* or *passages* are found in them, resembling the *Veins* of *Animals*. As may visibly be perceived in those *Plants*, whose *Juice* is *White*, *Red* or *Yellow*. The Principal Cause of which *Circulation* is, for that all here beneath, which partake of the *Circular Motion* of the *Earth*, strive to withdraw themselves from the *Center* of their *Motion*: For therefore it is that the *Juice* of the *Earth*, being entred into the *pores* of the *Root*, in the which it moves with the more ease than in the *Air*, endeavours to mount upwards, towards the higher parts of the *Plants*, and distributes its self to them, according to their several requirings, and that in such a manner, that the remaining crude Portion of the *Juice*, returns towards the *Root*, in order to receive there a new and further preparation.

IV. *Why Oyl is an enemy to Plants.*

Oyl is very hurtful to *Plants*, as being always destructive to them, when it reacheth their inward parts. And the same is observed by *Chymists* concerning *Quicksilver*, which is deleterious to *Trees* when ever it enters into the *pith* of them.

The Reason is, because *Oyl* by its *fatness* doth so obstruct the *pores* of the *Plants*, that the *particles* of the *Alimentitious Juice* cannot pass through them: Whereupon the *Plants* wither and die for want of due *nourishment* to support them. And *Quicksilver* is a *poison* to *Plants*, because by reason of its *subtilty*, it pierceth into their inward parts, dissolves the *Texture* of their *Fibres*, and introduceth a new disposition of their *parts*. And when this is done, the *Alimental Juice* can be no longer strained as it ought, and thereupon the *Plant* must needs fade and die.

V. *Why some Winds are hurtful to Plants.*

Trees sometimes *wither* upon the *blowing* of some *Winds*, and the young *Shoots* or *Sprigs* of them grow so *dry* and *sapless*, that they may be rub'd to *powder* with ones *hand*.

The Reason is, because these *Winds* abound with a *nitrous* or *vitriolick Spirit*, which invading the *green* and *tender Shoots* of *Trees*, do blast them with a consumptive infection, forasmuch as the tender *strings* or *fibres* which are like the *nerves* of the *Leaves* and *Sprigs*, become so compress and drawn together by the cold blast of the *Winds*, that they can no longer take in the *Aliment* conveyed from the *Root*. By which means the *Trees*, being deprived of all their *moisture*, become dried up, and die.

VI. *Why the top of a Sprig or Shoot sometimes withers.*

The *top* of a *Sprig* or *Shoot* sometimes *withers*, when yet that part which is near to the Stem continues fresh and vigorous.

This may happen from several *Causes*; either from an *obstruction* of the *pores*, or from some knot, or from a *dissolution* of the twisting of the *Fibres*: For by any of these means the nourishment is hindred from ascending after its usual manner, and from distributing it self to all the parts: Whereupon when the *moisture* which was at the *top* of the *Sprig* is exhaled, and the way stopt through which other should come to it, it must needs *wither* and *die*.

VII. *How Trees come to die by being bruised or bored.*

Trees do often *wither* and *die* by being *bruised*, *slit*, *bor'd*, or by some other *wound*.

The Reason is, because by *contusion* the order of the *parts* of a *Tree* is disturbed and confounded, and the passages obstructed, through which the *nourishment* passeth, and is conveyed to the further parts. Whence it comes to pass, that those parts which are above the *contusion*, do waste for want of *nourishment*, whilst those that are below it are choaked with too great abundance of it. In like manner *Plants* die also by *splitting*, or some other kind of *wounds*, because in this case, the *Alimentary Matter* ceaseth from passing through its *pores*, neither can it be distributed as it was before: And whereas some *Trees*, as the *Pine*, *Fir* and *Turpentine*, when they are *wounded* do thrive the better; this proceeds from the great abundance of their *moisture*, part whereof being evacuated by the *wound*, the *Plants* being rid of that which was their Burthen, bring forth *fruits* with more ease, and in greater abundance.

VIII. *Why some Plants perish by Heat, and others by Cold.*

Some *Plants* perish by too much *heat*, especially those that are *young* and *tender*, which are not yet sufficiently armed against the injuries of the *weather*. Others are destroyed by *cold*, and being seised with the *Frost*, die.

The Reason is, because the life of *Plants* consists in the temperature of *Heat* and *Moisture*, as hath been before-mentioned; so that *moisture* cannot continue long in a *Plant* without a mixture of *heat*; nor *heat* without *moisture*. Wherefore when either of these doth predominate, and destroy its compeer or fellow, the *Body* must of necessity die, and be deprived of Life. *Young* and *tender Plants* therefore are much sooner than others destroyed, because the outward *heat* does easily penetrate their tender *Bodies*, and by putting their parts into too vehement an agitation, doth extract and consume the *moisture*, not only out of the *Stem*, but out of the *Roots* themselves: And forasmuch as the loss thereof cannot be restored from out of the *Earth*, because it is likewise parcht up with too much *heat*, the *Plants* must needs *wither* and *die*. Others again do perish by *over-hard Frost*, which by locking up and contracting the *pores*, drives away the *heat*; whereupon the motion of the *Alimentary Juice* ceaseth, so that the *nutrition*, and consequently

the growth of the *Plants* muſt in time ceaſe alſo, and all their *vital functions* be interrupted. And for the ſame reaſon it is, that *Plants* are often killed by *Winds*, which if they be very hot, do open and widen the *pores*, and exhauſt the hidden *moiſture*: Whereas when they are *cold*, they compreſs the *pores*, and by expelling the *heat*, do weaken and waſte the natural ſtrength and vigor of them.

IX. *Why Wild Plants are longer liv'd than thoſe which grow in Gardens.*

Wild Plants, and ſuch as grow on *Mountains* and *Hilly Places*, are of longer continuance than thoſe which are cultivated in *Gardens*.

The Reaſon whereof ſeems to be this, becauſe the *Plants* which grow in *Gardens*, are frequently overcram'd by the abundance of *Alimentary Juice*, which does extinguiſh, or at leaſt weaken their natural *heat*. For ſince the deſign of *Gardning* is to bring forth goodly and early *Ripe Fruits*, the *Gardner* makes it his whole buſineſs to make his *ground* fat and fruitful; and is not at all concerned that his *Plants* be ſtrong and long laſting, ſo they do but thrive and bring forth abundance of *Fruit*. Now it is certain, that the *pores* of *Trees* are widened by the too great abundance of the *Alimentary Matter*, and an eaſie way being thus made for the *vital moiſture* to eſcape, the *heat* muſt needs vaniſh together with it. Another thing that ſhortens the *Life* of *Plants* is, becauſe the *dung* which is made uſe of to improve them, lies round about them, and that not far from the *ſurface* of the *Earth*; and by this means it happens, that they do not ſtrike down their *Roots* ſo deep in the ground, as otherwiſe they would: Whereas the *Plants* that grow *wild* in the *Fields*, being ſurrounded with more hungry and dry *Earth*, where they meet with but little *moiſture*, ſink their *Roots* deeper into the *Earth*, to provide themſelves a ſufficiency of ſuſtenance, and by this means grow much ſtronger, and more able to reſiſt all outward injuries, and conſequently endure longer. For it cannot be queſtioned, but that the *ſpreading* and *thickneſs* of the *Root* conduceth much to the laſting condition of *Plants*.

X. *Why hot Water deſtroys Plants*

Hence it is that *Gardners* obſerve, that thoſe *Plants die* within a ſhort time, that are watered with hot *water*: For tho' by this means their growth for the preſent ſeem to be promoted, and it makes their *Fruits* to be *ripe* the ſooner; yet becauſe the *Fibres* of the *Plants*, by this unaccuſtomed heat, are too much relaxated, and ſo take in too much *Moiſture* or *Juice*, they are either quite choaked by the too copious affluence of the *Alimentary Juice*, or elſe their *pores* become obſtructed by the bigneſs of the *particles* that come thronging in into them.

XI. *Why too cold Water is hurtful to Plants.*

And as it is of ill conſequence to *Plants*, if they be watered with *hot water*, ſo neither doth too *cold water* agree with them. And therefore skilful *Gardners* take care to ſet the *Spring* or *Well-Water* they make uſe of for the *watering* of their *Plants*, in the *Sun*, that the coldneſs of it may be ſomewhat temper'd and allay'd, for fear otherwiſe it might be prejudicial to the growth and thriving of them.

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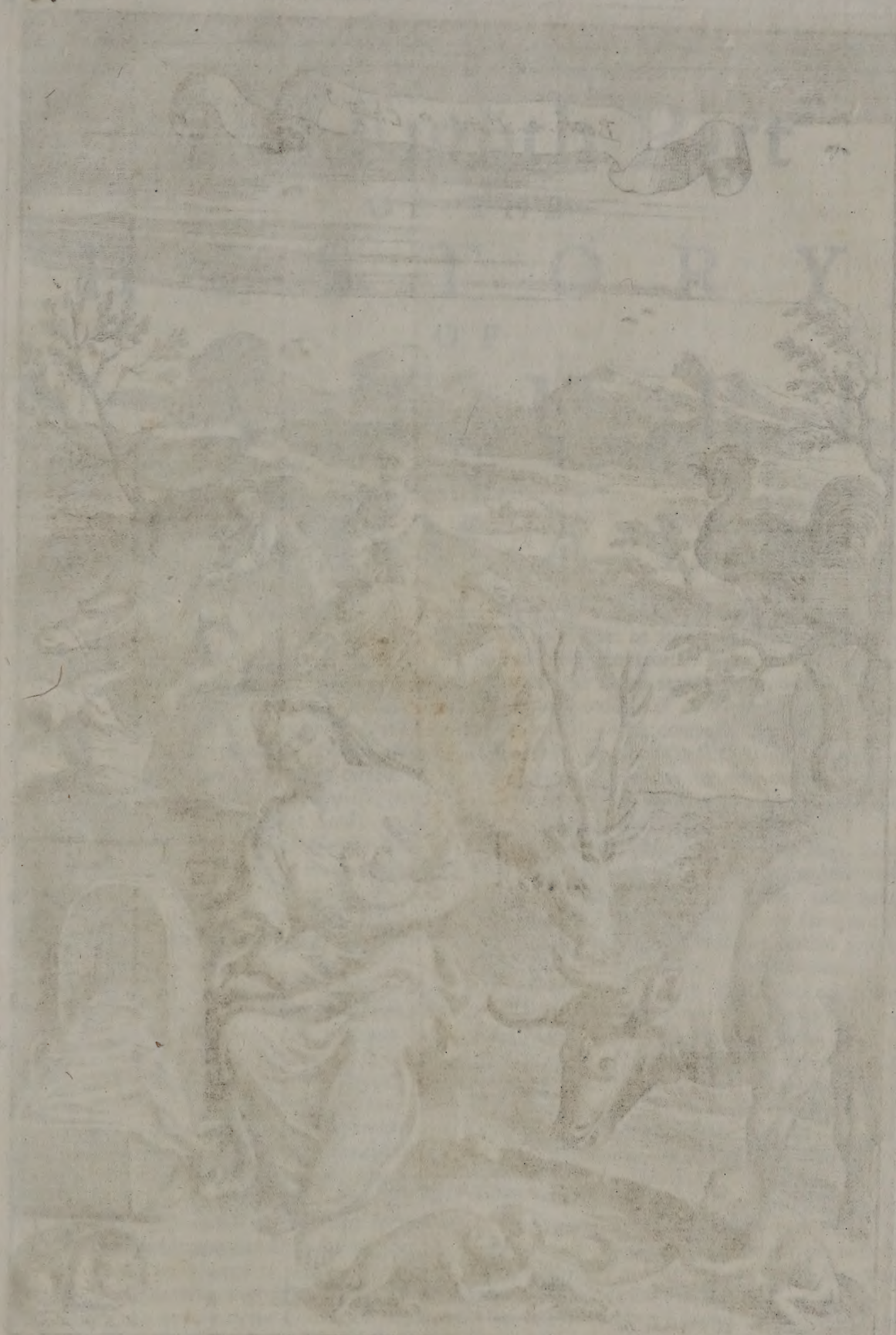

To the Right Wor= shipfull S.r William
Hooker of Greenwich in the County of Kent,
and of the Citty of London Knight,
and Lord Major thereof Anno Domini 1673.

This Plate is humbly Dedicated by Richard Blome.

The Eighth Part OF THE HISTORY OF NATURE. OF ANIMALS.

CHAP. I.

Of Animals which are commonly supposed to be of a Spontaneous Birth.

I. *Whether there are any Animals produc'd without Seed.*

THERE is nothing more vulgarly taken for granted among *Authors*, than that certain *Animals*, particularly *Insects*, are generated without *Seed*, as *Bugs* and *Lice* out of *Human Excretion* and *Filth*; *Book-worms* out of *Books*, *Wood-lice* out of *Wood*, *Moths* out of *Garments*, and innumerable others, which, as they say, breed and are produced without *Copulation* of different *Sexes*.

Some *Physicians* who pretend to be the only Inspectors into things of this nature, because they discern not with their *Eyes*, nor can any way comprehend the *Causes* which produce these *Animals*, call the *formation* of them Æquivocal, as if they sprang from different *Principles*, and their production had no manner of agreement with that of others; whereas indeed their *Generations*, by the same right as other *Generations*, are to be called Univocal; since they are effected by the same necessity, and no less than others, require a prævious *Seed* and requisit *Dispositions* therein. For whatsoever in Nature is produc'd, proceeds from *Seed*, and nothing in the *Earth* is *generated* by Chance, or contrary to the Course of Nature. True it is, that that sort of *Seed* is chiefly internal, and not always appearing to the *sight*; but that there is such a *Seed* latent in those *Bodies*, is not to be denied, since we find that *Lice*, *Bugs*, *Maggots*, &c. are curiously wrought and formed, each in their kind, and exactly agree among themselves in similitude of *parts*. For there is nothing wanting to their perfection; and they may be said to be no less compleat as to their *internal*, than *external parts*. For who can imagine, that so great a variety of *Members*, so exact a *Form* of each, so wonderful a *proportion* and *contexture* of *parts*, should fortuitously, and by an accidental Concourse of *Atoms* be produc'd, and that there should not rather be some necessarily determined *Seed* to bring them forth? For if we allow, for Example, that *Daws* among *Birds*, or *Cats* among *Beasts*, are produc'd of *Seed*, as being too elaborately fram'd to be compos'd by an uncertain *Agent*, why may not the same thing be judged of other *Animals*, when as we may observe in them a Structure no less exact and curious, and Parts no less correspondent each to other?

II. *Every Animal is engendred of Seed.*

But some *Philosophers* suppose, that *Bugs*, *Lice*, *Maggots*, and such like *Animals* are *generated*, while many *seminal particles*, as they call them, being agitated by a subtle *matter* or *heat*, are so disposed as to compose or constitute certain convenient *Figures* and *Organs*. For this *motion*, as they say, not rashly and by chance, but according to the *Laws* of *Nature*, and its *Seminary Virtues* proceed out of an aptly and well-disposed *Matter*, and determinated *Heat*; whereby it comes to pass, that the parts of the *Matter* so exagitated, not only conduce to the formation of the *Heart* and *Veins*, and the union of them with the *Arteries*, but also to compose the Principle of the *Brain*, the *Sensory* and *Motory Organ* of the *Fibres*, *Nerves* and *Spirits*, which things being first laid as a foundation, a farther progress is made to the forming of the perfect *Instruments*, those namely which contribute and are inservient to *Sensation* and the *Local Motion* of the *Body*.

III. *Of the breeding of Ducks or Geese from Trees in Scotland.*

To this *production* of *Animals* may be referred that which HECTOR BOETIUS makes mention of in his *History of Scotland*, namely, that on the *Sea-side* in some parts of *Scotland*, there is a sort of *Bird* ingendred of a certain *Tree*, that is, of the *Fruit* of it falling off and dropping into the *Sea*. The same thing or the like, he reports to be on the *Sea-coasts* of the *Hebrides Islands*, where such a strange kind of Production is said to be brought about two manner of ways. The one from *Ships*, or old *Planks* and pieces of *Timber*, which being left upon the *Shore*, and there remaining some time, breed from their corruption certain *Worms* or such like *Insects*, which discover-

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ing first *Feet*, then *Wings*, lastly *Plumes*, come at length to bear the similitude of *Ducks* or *Geese*, and like them take their flight up into the *Air*. The other is a *Hatching* as it were of certain little *Birds* out of Excerscences like *Snailes*, *Cockles*, or some kind of *Shel fish* sticking to the *Sea-weed* that grows in those parts, which are therefore supposed to proceed from the *Fruits* of *Trees*, because they are chiefly *hatcht* about that time, in which the *Leaves* or *Fruits* of those *Trees* that grow by the *Sea-side* appear and drop into the *Sea*. And indeed if *Fruits* hanging on a *Tree* can breed *Worms*, *Maggots* and such like *Insects*, why may there not as well out of the same *Fruits* be bred such *Animals*, as like other *Birds* take *wing* and glide to and fro in the *Air*?

IV. *Fishes engendred of Dew.*

I have been informed by Men of very good Credit, that if a *Hurdle* be plac'd over any *water*, whether a running *Stream* or standing *Pool*, and dewy *Turfs* be so laid upon it before Sun-rising, that the *Hearby-side* may be turned downward without shaking off too suddenly the *drops* of *Dew*, so many *drops* as afterwards upon the *Sun-rising*, and heating the *Turf* shall fall into the *water*, so many *Fishes* will be ingendred of them, and various, according to the diversity of the *Herbs* on which the drops of *Dew* fate.

Upon the truth hereof a certain Famous Man infers that from *Lakes*, *Rivers*, *Seas*, *Fishponds*, and all places in general, disposed to the ingendring of *Fish*, there are *Seeds* variously exhal'd, being conveyed through the *Air*, mixt and incorporated with the *Dew*, and falling upon the *Herbs*, are so cherish'd by the *Spirit* of them, and acquire such a disposition from them, that being receiv'd into the *water*, they are there form'd into these *Fishes*. In the same manner as from the *Dew* lying upon the *Leaves* of *Nightshade*, and warmed by the *heat* of the *Sun*, are ingendred *Worms*, as SCALIGER affirms; and as in *Chili*, a Province of *South America*, there grows a *Tree*, from whose *Leaves* small *Serpents* are said to fall.

V. *All Animals whatsoever are generated from the Egg.*

Now, tho' it hath been from Antiquity to this day the general opinion, that divers *Animals*, particularly small *Insects* are produc'd only by *corruption*; It is of late plainly evinc'd to the contrary by many Experiences. For besides those which I have quoted in my *Institution of Philosophy* touching *Insects*, we see that *Butterflies* by *Copulation*, produce an infinite number of *Eggs*, from which are hatcht *Canker-worms* of all sorts. Whence we may conclude, that all those *Animals* which are thought to be spontaneously ingendred, which are found in *Cheeses*, *Fruits*, and other sorts of *Food*, proceed from real *Eggs*, or at least from something equivalent to the *Seed* that comes from *Females* after they have been impregnated by the Company of the *Males*.

VI. *How Serpents have been generated in a Mans Brain.*

But HOLLERIUS in his 10*th* Book *De Morbis Internis*, Chap. 10. makes observation of a *Scorpion* bred in the *Brain* of a certain *Italian* by the frequent smelling of the Herb *Basil*. And RAIMUNDUS in his *Mercurius Italicus* affirms, that he found by experience, that the foresaid *Plant*, plac'd under a *Stone* in a moist place, within two days produc'd a *Scorpion*, which much at the same time, while he resided at *Siena*, a very rare and memorable accident confirmed. A certain Gentleman of *Siena*, wonderfully taken and delighted with the smell of this *Plant*, used frequently to snuff up into his *Nose* the powder thereof dried, but highly to his cost, for in a short time he died *Mad*; whereupon his *Skull* being open'd by a *Surgeon*, a *Scorpions Nest* was there found: And this might possibly be, in regard the *Scorpion*, being delighted with the smell of that *Plant*, creeps with a great desire to it, lodges in it, and haply feeds upon it, and may chance also to lay its *Eggs* in its *Leaves* and *Buds*: Whence it might easily happen, that the foresaid Gentleman might, together with the Powder snuff up into his *Nostrils* some of the *Scorpions Eggs*, which cherish'd by the heat of the *Head*, might well enough hatch young *Scorpions*.

VII. *Locusts bred of the Seed of Flies.*

So the *Ukrainians* are mightily infected, especially in a *dry Summer*, with *swarms* of *Locusts*, by reason these sorts of *Insects*, before they expire, leave each of them behind them 2 or 300 *Eggs* in *Autumn*, which afterwards by the next *Summers heat* are hatcht into *Locusts*, which unless they be swept away by the following *Rain*, or driven by the *Northerly Winds* into the *Euxin Sea*, spoil all the Corn, and inflict vast damages upon those *Provinces* through which they travail. Some there are, who, by diligent observation, have made this remark, that never any *Insects* are *generated* of the Flesh of *Beasts* or *Fish*, except they have been first *Fly-blown*, or tainted with the *Seed* of *Flies*; and consequently that *Vermination* in *Flesh* proceeds only from *Flies*, altogether like to those which afterwards breed in *Flesh*.

VIII. *Bees generated out of Heifers.*

VIRGIL in his 4*th* Book of *Georgicks* affirms, that from a *Heifer* of two year old, having its *Nose* stopt, and being beaten to death, its *Bowels*, after it is killed, being spread over its whole Skin, *Bees* are generated, provided this be done about the beginning of the *Spring*, and before Herbs shoot forth into Flowers. This, (as we suppose) may very well be, in regard the *Heifers* about the beginning of the *Spring*, feed upon *Thyme* and *Cassia*, which soon after shooting forth into *Flowers*, contain little *Eggs*, which being agitated by *heat* and the *subtil matter*, are dilated, and at length are delivered of these little *Animals*. For what the common belief is of most men, is absolutely false, namely, that *Bees* are generated out of the corrupted *Carcases* of *Oxen*. However this seems more likely than that *exterior Causes* should be able to meet so opportunely, as to build or frame *Organs* of *Animals*, such, as whose *fabrick* or *structure* can be comprehended by no human understanding unless perhaps some *Seminary* and *Plastick Virtue* lie hid in the said *Bodies*, which being scarce credible, it seems a much greater probability, that all *Generation* is univocal, and that almost all *Animals* are procreated by others of the same kind.

IX. *Animals discovered in a mixture of Pepper and Water.*

And much after the same we may determin concerning *Animals* discovered in *water*, wherein *Pepper* hath for the space of three days been infused. For altho' they are too minute to be well discerned by our *Senses*, yet they are fram'd with so great and almost infinite variety of *Organs*, that they must needs be allowed to be the progeny of others of that kind, and most likely it is that their *Eggs* have lain hid in the *Pepper*.

Worms

X. *Worms bred in Fruits.* *Worms* are *generated* in *Fruits*; and *Flies* which are ſo numerous in *Summer*, cannot be produc'd by any act of *Generation*, ſince the whole race of *Flies* being deſtroyed, there can be none ſurviving to produce others.

Worms are bred within the Pulps of *Fruits*, not ſpontaneouſly, as if there were nothing in the *Fruit* before, from whence they may be *generated*, but from a premiſed *Seed*, that is to ſay, while *Bees* or *Flies*, ſitting upon *Flowers*, leave behind them certain little *Eggs*, which being intercepted within the *Fruits*, are diſcloſed by the urging heat, and turn into *Worms*. Thus *Fruits* and *Herbs* breed *Worms*, when they are expoſed to the *Air*; and ſometimes in one and the ſame *Plant*, divers ſorts of *Inſects* are to be ſeen: But if any Plant be incloſed within a *Veſſel*, and the ſaid *Veſſel* be kept cloſe ſtopt, ſo that the *Air* can have no acceſs, no *Worms* will there breed from any *putrefaction*; nor is *Cheeſe* capable of breeding *Mites*, if kept in a *Glaſs Vial* well ſtopt and Hermetically ſealed.

XI. *Flies are generated of other Flies.* So *Flies* are not bred ſpontaneouſly, but by a premiſed copulation, and of *Eggs* laid, which being promiſcuouſly diſpers'd in the *Earth*, and afterwards cheriſh'd by *vernal heat*, are deliver'd of the *reſpective Animal:* For if PLINY may be credited, *Flies*, as alſo *Ants*, *Beetles*, *Bees*, *Spiders*, *Waſps*, and other ſuch like *Animals* generate by commixture or copulation; and this is chiefly to be prov'd by this one *Argument*, namely, becauſe ſome years, *Flies*, *Locuſts*, &c. are more abundant than others, make greater waſte and havock in the *Fields*, and more infeſt Mankind, which certainly can be from no other cauſe, but for that in a mild *Winter* they were preſerv'd and not deſtroyed by the coldneſs or moiſture of the Earth.

XII. *How Worms breed in the Maws of Infants.* Wherefore by no means can we aſſent to thoſe *Peripatetick Phyſicians*, who affirm that *Maw-worms* are bred in the *Inteſtines* out of *putrefaction*, by the means of *Heat*; as in like manner they aſſert of other *Inſects*, that by the heat of the *Sun* they are produc'd out of *Horſes*, *Cows* or other *Animals Dung*. But it may more probably be alledged, that the *Maw-worms* have their *production* from the little *Eggs* of *Inſects* ſwallowed down by *Children* with their *Meat*. For our *Meat* cannot be ſo exactly preſerved, but that it may by ſome way or other be contaminated by inviſible *Inſects*, which continually fly up and down in the *Air*. And whereas the *meats* ſwarming with thoſe *Eggs*, are conveyed into the *ſtomach*; the ſaid *Eggs* by this means remain entire, and being cheriſh'd by a gentle *heat*, are at length delivered of theſe *Worms:* And for a clear demonſtration hereof it is to be obſerved, that *Children* during the time they *ſuck*, are never troubled with *Worms*, nor are they in the leaſt ſubject to this Diſtemper, till they come to feed upon more ſolid *meat*; whereas before they immediately drew their nutriment from the Breaſts, in which none of theſe little *Eggs* could harbour. But when they come to feed upon *external nutriments*, they are then more expoſed to the breeding of *Worms*, becauſe the fermentations in thoſe *nutriments* are not powerful enough to deſtroy the *Eggs*.

XIII. *That ſome Flies are viviparous* ALDROVANDUS in his firſt Book of *Inſects* affirms, that ſome *Flies* are *viviparous* or capable of bringing forth living *Flies: I took*, ſaith he, *when I was young, being entic'd by the ſpecious form thereof, one of the bigger ſort of Flies, ſtreakt with ſeveral white Lines; which when I had kept ſome time in the hollow of my hand, I perceived at laſt proceeding from it, certain ſmall white Worms crawling up and down.* And tho' he ſpeaks but of his catching one only *Fly*, which had *Worms* living and moving within her womb, yet it may eaſily be imagin'd, and inferred that the reſt of that kind are alſo *viviparous*.

XIV. *Whether Mares may be impregnated by the Wind.* Some *Animals* become pregnant by the *wind*, as PLINY relates of *Mares* in *Spain* and *Cappadocia*, in his Eighth Book, Chap. 42. *It is certain*, ſaith he, *that in* Portugal *on the Banks of the River* Tagus, *near* Lisbon, *there are certain* Mares, *which turning their Face to the* Weſt-wind, *when it blows, conceive thereby an* Animal Spirit, *which proceeds to a Birth, that is brought forth into the world with wonderful eaſe and expedition, but retains not life beyond the term of three years.* This the *Ancients* gave credit to, but I fear, not upon ſo exact examination and enquiry, as a matter of this nature requires; ſince ſure enough it is that *Generation* cannot be effected without the coition of *Male* and *Female*, unleſs perhaps that which they call *Hippomanes*, be taken for a Birth, that I ſay, which *Mares*, while they are expoſed to the wind, emit. I have ask'd ſome *Portugueſes* whether or no it were true which ſome Ancient Authors have delivered concerning the fruitfulneſs of the *Portugal Mares*, and whether any ſort of Wind was ſo efficacious as to deſerve to be termed a Father of Living Creatures. Of theſe perſons, ſome profeſſed themſelves totally ignorant of the matter; others, whom the reading of Ancient Authors had incited to a more narrow ſearch and enquiry into Antiquity ſaid, that they had heard indeed that *Mares* ſometimes bring forth certain miſhapen and formleſs Maſſes, or lumps of Fleſh, having nothing of reſemblance with the ſhape of a *Horſe*, or any other *Animal:* But this happens very rarely, and that too, only when they are high fed, and raging with deſire of *Copulation*, are kept from the company of the *Male*. Whence we cannot but admire that PLINY, COLUMELLA, and other Accurate *Writers* of *Natural Cauſes*, ſhould make mention of this ſtrange ſort of *Geniture*, which neither they themſelves had obſerved, nor could warrant the truth thereof to the World by any ſufficient Teſtimonies; except we compare this opinion of theirs concerning the fruitfulneſs of thoſe *Mares*, and their celerity of Birth, with ſome conceits of *Juſtine* the *Epitomizer*.

XV. *Vulturs falſly given out to conceive by the Wind.* Nor is it with leſs incertainty, that AELIAN in his 2*d* Book of *Animals*, aſſerts the *conception* of *Vulturs* by the *Wind*, and their expoſing their hinder part to the *North-wind*, to be as it were trodden and impregnated by the ſaid *Wind*, ſince among *Vulturs* there is known to be a *Male* and *Female*, by the *conjunction* whereof *Generation* is produc'd, according to the common direction of *Nature*. Moreover, their *Neaſts* are diſcovered, and they are known to couple at ſet times of the year. Nor ſignifies it any thing to ſay, that ſome *Animals* lay *Eggs*, which from the *Wind* are called *Hypenemious* or *Subventaneous*, that is to ſay, indeed *Wind-trodden Eggs*, as *Hens*, *Partridges*, &c.

which before such time as they have experienc'd Coition, emit those *subventaneous Births*: Since these sorts of *Eggs* are barren, smaller and more liquid than those, which being produc'd by *Copulation*, are capable of fæcundity. Nor can the liquor of them by any brooding of the *Hen* be brought to thicken, but still remains what it was at first.

XVI. *The Pyraustæ breed in flames of fire.* In the *Braß Fornaces* in the *Isle* of *Cyprus*, where the *Stone Chalcites* being cast in, is many days a *burning*, there spring up on a sudden in the very midst of the *Fire*, certain little winged *Animals*, called *Pyraustæ*, somewhat bigger than great *Flies*; which nimbly run and frisk up and down in the *fire*. ARISTOTLE makes mention of them in the 5*th* Book of his *History of Animals*, Chap. 19.

These *Pyraustæ* breed not of the simple substance of the *fire*, but out of *Eggs* left by this kind of *Animal* in the *Stone Chalcites*; for I cannot but perswade my self, that this *Chalcites* in the Mines is condenst out of a certain *Juice*, from which, as from a kind of Vehicle, certain *Eggs*, apt for the generating of these *Pyraustæ*, proceed out of some *Vegetable Body*; so that in fine the *Pyraustæ* themselves are procreated out of these *Eggs*, the fat humour being mixt to the *Metallick Matter*, and thereupon live unhurt in the *fire*. In regard such is the temper of the *Matter* whereof they consist as long to endure the *fire*, and like *Adianthum* to elude the strength of the *flames*. St. AUGUSTIN in the 21*st* Book of his Treatise *De Civitate Dei*, mentions also a sort of *Worms* found in *bubling Streams* of *Water*, so hot, as not to be touch'd without scalding.

XVII. *A certain sort of Wood incombustible.* TORNIELLUS in his Book of the World, takes notice of a light kind of *Wood*, and to all outward appearance combustible, said to be brought from the Mountains of *Java*, whereof a small portion hath been cut off with a *Knife*, and cast into a large *Coal Fire*, and not been consumed, nay, not so much as lighted, impaired or diminished; but being taken out, hath appeared as if it had never been cast into the *fire*.

XVIII. *The vulgar opinion of the Salamander.* And altho' the same thing be vulgarly reported of the *Salamander*, yet I dare not maintain it as a compleat truth, since most certain it is, that at *Rome* a *Salamander* being cast into the *fire* by *Corrini*, a *Roman* Knight, immediately swell'd, and sent forth a fat thick matter which quench'd the *Coals*, and by repeated *vomitings* endeavoured to defend himself from the cruel Ardours of the *fire*.

XIX. *Some sort of Linnen which no fire consumes.* LEMNIUS saw, as himself attests, *Mantles* Knit or Woven of a certain incombustible sort of *Flax* which yield not to the *fire*, and are invincible to the hottest *flames*; insomuch that if at any time these *Clothes* come to be sullied, or contract any thing of *Soil* or *Spots*, there is no need of *Soap* or *Lie* for the taking out of these *Spots*, but the *Garments* are thrown whole into a great *fire*, and immediately become all in a blaze as if bedawb'd with *Grease*; but being taken out, they are fresh, and cleansed of all their *Spots*. The same sort of *Plant* is said to grow in the Desert and Sandy Parts of *India*, whereof some *Stocks*, acquire from the condition of the Soil, and quality of the Ambient Air, such disposition as to be capable of being woven into *Linnen*.

CHAP. II.

Of Animals produc'd of Seed.

I. *Whether Whitings and such like Fishes are of one Sex only.* SOME *Animals* are thought to be of one *Sex* only, and to *Generate* and bring forth without the *Male*, as ARISTOTLE in the 11*th* Chapter of the 4*th* Book of his *Natural History*, relates of *Rochets* and *Plaice* among *Fishes*; which when they are taken, are found to have *Eggs*. The same thing is affirmed of *Oisters*, and some other *Shell-fish*, that they are impregnated with their own proper *Seed*, and that they breed and bring forth their like without Natural Coition.

Those that stand up for *Aristotle* and right or wrong defend whatsoever hath been wrought by him, admit, without the least difficulty, this assertion of his, because he Judges so, Writes so, and will have it so: But we who prefer Truth before *Aristotle*, and think nothing fit to be received which is not consentaneous to Reason and Experience, reject his Assertion as *Fabulous*, as having conferred with Men of undoubted Credit and Reputation, who affirm that they have seen *Rochets* without Spawn, and *Plaice*, *Male* and *Female*, in conjunction together. And indeed it is utterly repugnant to Reason, that any *Animal* should procreate by it self, and propagate its *Species* without the help of another. So that I am apt to believe that *Aristotle* delivered not this to be his Sentiment, as totally relying upon his own proper *Judgment* or *Experience*, but rather by suffering himself to be led aside by the Credit of those *Fishermen* whom he had hired to discover to him the Nature and Properties of *Fish*. The same may be said of *Oisters* and such like *Shell-fish*; since there are many who affirm that they have seen *Horn-fish* and *Purples* in *Conjunction* each with their kind: Nay, and that they have observed their *Meeting* at set times of the year to perform the said work of *Generation*.

II. *That Children sometimes inherit the defects of their Parents.* *Women* that are maimed or deprived of one or more *Limbs*, sometimes bring forth *Children* affected with the like *Mutilation*, as that *Woman* mentioned by GASSENDUS, who having formerly brought forth many Children perfect and intire, afterwards when she had lost one of her *Fingers*, brought forth several *Children*, in like manner, deficient. Sir KENELM DIGBY gives us a Relation of a certain *Woman* whom he saw in *Barbary*, who having two *Thumbs* on her Left *Hand*, was attended by four Daughters, whom she brought forth thumb'd in like manner.

Ancient *Physitians* generally alledge one main cause of these and the like effects, namely the defluxion of the *Seed* from all parts of the *Body*: Forasmuch as since the *Blood* is carried by a perpetual motion through the *Body* of the *Animal*, it is not to be doubted but that the *subtil part* thereof adapted to *Generation*, by passing through all its parts, is concocted by every one of them, and affected in a certain peculiar manner, so that it partakes of the qualities of each, and carries them along with it to the *Heart*, whereunto it tends; and where it is separated from another more gross part, and laid up in receptacles appointed by Nature. And this, say they, is the *Seed* which every *Animal* makes use of for the *Generation* of others like

like it self. So that if it chance that the *Animal* from which that *Spermatick Matter* is drawn, wants any *Limb* or *Member*, no *virtue* of the said Member will be in the *Blood*, and consequently the *Birth* will come forth *maimed*, or destitute of some part or parts. Or if any part or parts in the *Annimal* exceed, as Sir *Kenelm* relates of the *African Woman*, or there be any exuberance or excrescence of *Flesh*, the same deformity will be also concomitant to the *Birth*, unless this redundancy be temper'd by the *Seed* of the other *Parent*, or the superfluity of the *Blood* be corrected.

III. *Defects, Diseases and Vices of Parents entailed upon their Children.*

And for the same cause they say it is, that they who are troubled with the *Gout*, *Epilepsie*, *Leprosie*, or any such like contagious *disease*, impart the same to their *Births*: Especially the *Mothers*, since they afford them *Aliment*, and together with the *Blood*, the habit of *Body*, as they likewise communicate the *manners* and *dispositions* of the *Mind*. Hence commonly it falls out that *lewd* and *drunken Women* bring forth *Children* of the same temper and like themselves entailing their *vices* on their *Offspring*.

IV. *How Children come to be markt with their Parents defects.*

But as in *Fruits* it may possibly be conjectur'd, that the *Buds* and *Efflorescences* have been form'd in their original exemplar from the beginning of the *world*; so the like is to be inferr'd in the production of all *Animals*; and tho' it may seem very difficult to comprehend how the *form* and *features* of *Parents* are imprinted in the *Births*; yet if we seriously consider it, we shall find it not so hard a matter to conceive as we think, that the *figure* of a *Body* so small, and so flexible as is that of an *Embrio*, may be diversly modified, whether it be by the *Bodies* which serve to extend and enlarge it, or by those which close or compress it, or by the *imagination* of the *Mother* which hath power to remove the *humours*, and consequently to cause them to flow towards some parts rather than others. For when they fail to bend their motion towards some parts of the *Infant*, then it is that the *Infant* is born with the Defects of the *maimed Parent*.

V. *How Exuberances or Additions of Parts happen.*

And on the contrary, if it happen that they have exuberances or more parts than belong to a compleat *Birth*, as two *Heads*, or the like; this addition of *parts* may be attributed to the meeting of two Eggs hitting together, or whose parts have been disordered, intermingled, or crusht together through the motion of the *Humours*, several ways, by the *imagination* of the *Mother*.

VI. *The Cause of Womens Barrenness.*

Some *Women* are undoubtedly *barren* and uncapable of ever bringing forth *Children*, and the reason is evident from things already discourst of in our *Institution* of *Philosophy*; namely, that every *Egg*, in its proper receptacle, that is, the *Womens Testicles* is rendred fruitful by the *Virile Contact*, that the *Egg* thus fœcundated or fructified, increases daily more and more, and is at length shut up in the *Womb*, and is there, as it were, ripened with *heat*, till such time as it hath received all its *Lineaments*. So that *Women* are *Barren* when their *Eggs* are either intemperate, or hardned, or wrapt in a *Membran* too thick to be fermented by the touch of the *Virile* or *Male Seed*; or because their *Eggs* are too small or juiceless, so as to contain little or nothing in them, or else because their whole *Bodies* are intemperate or full of gross *humours*, or are over fat, or because they are troubled with the *Whites*, or have their *Courses* too much. But of all others, the chief cause of Sterility is said to consist in the obstruction of the *Fallopian Tubes*, since if these chance to be obstructed, the *Seminal Spirit* cannot reach the *Ovary* to fructifie it.

VII. *Women deprived of the usual benefit of Nature, are barren.*

Women, whom the Monthly benefit of Nature fails, are *barren* and *void* of all fœcundity.

The Reason is, because at such a time the *Vessels* being obstructed, the passage is rendred uncapable to transmit the Genital Air to the *Ovarium*. Whereas *Women*, when their *Courses* begin, and more especially when newly over, are sooner impregnated and conceive, because the *Womb* is moist with a certain roscid *humour*, and more easily attracts and retains the *Seed*.

VIII. *When the Menstruous Fluor begins in Women.*

Women have not their *Courses* at the same time in all *Countries*. In very hot *Climats*, for the most part, the *Profluvium* begins in the *7th* or *8th* year: So the story goes of an *Indian Girl*, who was married at seven years old, and at eight brought forth a Boy. In *temperate* Regions at 12 or 14; in *cold* Regions seldom before the *16th* or *18th* year of Age: In persons very young these *Fluors* break not out, both in regard the *Blood* is for the most part taken up in the *nutrition* of the *Body*, as also because the *Blood* is not sharp enough to open easily the *Mouths* of the *Vessels*: In *Women* growing into years it ceases, in regard the *Blood* thickning for want of due fermentation, is not so fluid as in the strong and youthful.

IX. *Whether She Mules are barren, and for what cause.*

She *Mules* are generally accounted barren and uncapable to bring forth their like.

The Cause of this sterility in *Mules*, Modern *Physitians* attribute to the want of *Eggs* in the *Womb*. For STENO, who first discovered and made publick the *Ovary* in *Women*, affirms that *Mules* have indeed *Testicles*, but are destitute of *Eggs*, and therefore no wonder they are so barren, since they have not like other *Animals*, *Eggs* in those *Testicles*.

However some there are that question this Tradition, and assert that she *Mules* are not altogether barren, since there have been *Mules* known which have brought forth; particularly there was one of late in *Auvergn* that brought forth a young *Mule*. And PLINY quotes *Theophrastus* his Testimony, that *Mules* in *Cappadocia* bring forth not only those that are generated of a He *Ass* and *Mare*, but also such as are begot of *Mares*, and wild *Asses*, tho' this seldom happens by reason of the great difference of parts which constitute the *Womb* of a she *Ass*, and those which constitute that of a *Mare*; forasmuch as the *Asinine Birth* possesses those *Caruncles*, *Placents* and *Zones* which the *Equine Birth* is destitute of. Wherefore it must needs be, that whereas a *She Mule* partakes not of all those parts, she cannot but be barren, unless some extraordinary accident happen.

XI. *A too frequent effusion of Seed hurtful to the Brain.*

Overmuch effusion of *Seed* is very hurtful to the *Brain* and *Nerves*, and creates an extraordinary weakness in them, as those persons by experience find, that too much indulge to *Venery*.

HIPPOCRATES was of opinion, and to this day it is the belief of many *Physitians*, that the *Genital Humour* is derived from the *Brain* into the *Spermatick Vessels*, whereof when-ever there is any evacuation made, the *Brain* must of necessity

neceſſity be weakned. But ſince there appears no peculiar Channels from the *Brain*, which can convey the foreſaid *humour* to the *Spermatick Parts*, it is moſt conſentaneous to reaſon, that this noble *humour* is generated out of the *maſs* of *Blood*, or as others will have, out of the *Nutricious Juice* and *Animal Spirit* well compounded, whereof ſome part is no leſs diffuſed to the *Genitals* than to the *Brain*. But that the overmuch waſtings of the *Genital Humour* ſhould endamage and weaken the *Brain*, that ariſes from hence, namely becauſe the *Blood* to repair the *ſpent Seed*, puts the *Brain* to the expence of its moſt ſubtil part to ſupply the *Spermatick Veſſels* with a ſufficient quantity of *Animal Spirits*. Nay, when the *Blood* out of its own ſubſtance cannot contribute ſufficiently to the *Genitals*, it claims of the *Brain* a Grant of new matter formerly borrowed on purpoſe.

XI. *Children generally reſemble one or other of their Parents.*

Children moſt commonly are like to one or other of their *Progenitors*, and ſometimes reſemble both. Some *Women* have the reſemblance of the *Grand Father*, *Great Grand Father*, or ſome other of their *Anceſtors*. As that *Græcian Woman*, mention'd by PLINY, being accuſed of *Adultery* becauſe ſhe had brought forth a *Black*, was acquitted and judged innocent when it appeared that ſhe was but the fourth degree removed from an *Æthiopian* Anceſtry.

It is a common opinion of ancient *Phyſitians*, that if the *Womans Seed* abound, the *Birth* becomes like the *Mother*; if the *Mans Seed* predominate, it is moſt like to the *Father*; but if there be an equal proportion on both ſides, that then there is a reſemblance to each party alike; and to this purpoſe and almoſt in the ſame terms LACTANTIUS expreſſes himſelf.

XII. *The Reaſon of the reſemblance of Children to their Progenitors.*

But I rather think, as I ſaid a little before, comparing the *Germination* of *Plants* with the *Production* of *Animals*, that the reſemblance of *Children* to *Parents*, is not cauſed by the exceeding quantity of *Seed*, either of the one or the other *Parent*, but rather becauſe the *Seed* of the *Male*, making way into the Pores of the *Eggs*, opens them in ſuch a manner, that they are more diſpoſed to receive the matter whoſe *particles* reſemble thoſe of the *Male Seed* than to admit of others, by reaſon whereof the *particles*, which make up the compoſition of the *Infants Body*, rank themſelves in ſuch ſort as thoſe are rank'd which compoſe the *Fathers*; and this is the true cauſe of *Father* and *Sons* reſembling each other. The ſame reaſon may be given of *Infants* being *born* with a reſemblance to the *Grand Father*, or any other Anceſtor, whom neither *Father* nor *Mother* ever knew. For it may eaſily be conceiv'd, that Anceſtors may poſſibly have impreſt in their begotten *Off-ſpring* ſuch ſort of diſpoſitions, that the parts of their *Seed* cauſe in the *particles* of the *Eggs* thoſe particular ſtructures which are proper to produce in the *Birth* a *Figure* modified rather one way than another.

XIII. *Whence it is that ſome Children are born Lame, others Gibbous.*

But ſome will ſay, if *Infants* are thus incloſed, and as if it were fenc'd about in *Eggs*, how comes it that ſome are born *Lame*, others *Gibbous* or bunch backt?

This happens when the *Infant* is ſo ſtreightned in the *Womb*, that all the parts cannot grow proportionably; whether it be that that the *Womb* is too little, or becauſe the parts of the *Birth* are diverſly affected by ſome exteriour cauſe. For by this means the *Infant* muſt needs be out of order, that is, muſt have ſome *Member* greater or ſmaller, or otherwiſe diſpos'd than the natural conſtruction of the Body requires.

XIV. *How it comes to paſs that ſometimes Wiſe Men beget Fools.*

Hence it is that wiſe men oft beget *Changelings*, or *Children* of little or no *underſtanding*: Becauſe having their *minds* imployed in ſubtil inventions, or ſome ſerious points of *Learning* or *Art*, they little mind the *Sports* of *Venus*, and are very ſlack and indifferent in the performances thereof. On the contrary, thoſe that are eagerly bent upon the *Act* of *Generation*, for the moſt part beget *Children* of like *Affections*, *Manners*, *Studies* and *Inclinations* of *Mind*. For thoſe *Children* in whom vigour of Soul and *Vital Spirit* is infuſed from the faculty of the *Seed*, cannot but be of the ſame Diſpoſition, Nature and Temperament with their *Progenitors*.

XV. *Whence it is that the Women of* Holland *bring forth Harelipt Children.*

The *Matrons* of *Holland* by looking earneſtly upon a *Hare*, oft-times bring forth *Children* with the Upper-Lip divided, or as we commonly call them *Hare-Lipt*. In like manner, ſome have Flat *Noſes*, Wry *Mouths*, Blubber *Lips*, and a habit of *Body*, all over deformed.

The Reaſon is, becauſe *Women* in the time of their *conception* or going with *Child*, have many times their *Eyes*, *Thoughts* and *Fancies* ſtrongly fixt upon ſome or other miſshapen or ill favour'd ſight: For ſuch is the force of *Imagination*, that when a *Woman Looks* or *Thinks* upon any thing very earneſtly, ſhe commonly brings forth ſome thing very nearly reſembling the thing ſo *ſeen* or *thought* on. So a certain *Woman* not forgotten in ſtory, who having caſt away all ſhame, while her *Husband* was abſent, and proſtituted her ſelf to another perſon, brought forth a Child no way like to the *Gallant*, but the very Picture of her abſent *Husband*: The cauſe whereof is Elegantly and Wittily deſcribed by Sir *Thomas More* in one of his *Epigrams*.

* XVI. *Whence it is that Children are brought forth like to the things beheld.*

The like is related by GALEN, namely, that a certain *Woman* brought forth a *Child* not at all like the *Father*, who was naturally deformed in Body, and of an ill-favour'd Viſage, but to a fair *Image* or *Picture* which her *Husband* had often deſired her frequently to caſt her *Eyes* upon. And PORTÆUS makes relation of another *Woman*, who delighting as it were by a natural propenſity, to have frequently in her *ſight*, and oftner in her *mind* a *Statue* of *Marble* repreſenting a Fat Boy, brought forth a kind of *Man Child* Pale and Wan, and indeed wholly reſembling the ſaid Statua. Nor is this peculiar only to *Human Race*, but common alſo to *Brute Animals*, of which more in the following Chapter.

XVII. *How Twins are generated.*

Whence it is that *Twins* are brought forth at one Birth.

Ancient *Phyſitians* were of opinion, that the *Womb* is diſtinguiſht into ſo many *Cavities* or *Cells*, divided by *Membrans* from one another as there are *Births generated* in the *Womb*; but the contrary is proved by experience. For the *Womb* hath in reality but one continued *Cavity*; and the truth of the matter is this, when ſeveral *Births*, at one time are *generated* in the *Womb*, they are contained each in their proper *Membrans*; ſo that if two, three or more *Births* are conceived, it is when the *Male Seed* hath been very ſpirituous, even to the im-

impregnation of ſo many *Eggs*, with the ſame fruitfulneſs through the *Fallopian Tubes*, as if there were but one, which being driven down to the bottom of the *Womb*, are there each of them fructified.

XVIII. *Whether Iſſues diſpoſe to Barrenneſs.*

It is a *Vulgar Maxim* among *Women*, and by ſome taken for a certain truth, eſpecially here in *England*, that if a *Woman* have but one Iſſue, ſhe is condemned to Sterility or Barrenneſs, and much more, if more. Therefore to married *Women* that are in expectation of *Childing*, this ſort of application, tho' otherwiſe thought very conducible to *health*, is moſt ſtrictly forbidden.

But of this Interdiction I have yet found no juſt reaſon alledged, only there are cited ſome *ſtories* of *Barren Women* with *Iſſues* about them; but it would not be difficult to produce relations of very many *Barren Women* without *Iſſues*, and of many *Fruitful ones* which have them.

CHAP. III.

Of Monſters.

I. *What a Monſter is.*

THOSE we call *Monſters* are Natural *Births*, or Natural *Living Creatures* degenerating from the due and wonted diſpoſition of their *Species*. Now they are ſaid to *degenerate* if there happen any ſuperfluous *Member*, or any neceſſary one be wanting, or any part be in a wrong place, or be of another kind than what it ought to be; ſo that thoſe perſons are ſaid to be *Monſtrous* who are either born without *Arms*, or with more than ought to be, or have them in a wrong place, as in the *Thighs*, or have the *Head* of a *Ram*, or other unhuman *Creature*, not to mention ſeveral other accidents of this nature.

II. *Of a Two-headed Twin Fac'd and double-breaſted Birth.*

There goes a tradition of a *Boy*, born in the Reign of the Emperor *Theodoſius* at *Emaus*, who from the *Navil* downward was perfect as others of his kind, but upwards was all double; *Head*, *Face* and *Breaſt*, had the uſe of his *Senſes*, and of all his double parts by turns, while one *eat* and *drank* the other abſtained, and with the like viciſſitude while one *ſlept*, the other *waked*; while one *ſported*, the other was *ſerious*; diſcovering hereby effects of a different *Mind* and *Temper*, and in this manner he lived near two years.

III. *A Child born without a Head. Another without Feet, others without Hands or Feet.*

In 1504. in *Miſnia*, a *Child* was born without a *Head*, his *Eyes* being placed in his *Breaſt*. Another in *Nebritz*, not far from the City *Wutz* was born without *Feet*. Others the *Roman Hiſtory* mentions born without *Hands* and *Feet*.

IV. *A Monſter with one Arm in the Ear, and another in the Side.*

In *Stetin* was born a *Monſter* ſhaped as followeth, in the place of the *Head* there was an unformed *Maſs* or *Lump*, riſing and ſinking like a *Sheeps Intrals*; in the place of one *Ear* ſtood out an *Arm*, where the *Face* ſhould be, there was a tuft of *Hair* like a Cats Fur, and the Spawn of a Pike Fiſh, through the lower part whereof the *Eyes* caſt a ſplendor like *Glaſs*; the *Mouth* was contracted into a little hole, without *Lips*; there was ſomething like a *Noſe*, but wonderfully ſmall; nor was there any appearance of a *Neck*: Another *Arm* ſtuck out from one ſide, but there was no ſign either of *Back* or *Breaſt*, excepting that a little ſmall Line ſeemed to ſupply the place of the *Back-bone*; it was neither *Hermaphrodite*, nor of any *Sex*. There was alſo in the year 1516. another ſtrange *Creature* born, which lived to be a *Man*, having no other *Head* but what grew out from the *Navil*, yet it took in nouriſhment as freely as if it had been in its proper place.

V. *A Monſter born with the Head of a Dog or Ape.*

In 1560. there was born at *Baſil* a *Man-child* with a fierce and grim *Viſage*, having indeed an indifferent well compacted *Body*, but *Head* and *Face* all hairy, and more reſembling that of a *Dog*, *Cat* or *Ape*, than of a *Human Creature*. He liv'd no longer than about an hour and a half. Near *Lauffenburg*, a Town in *Germany*, on the Borders of *Switzerland*, a *Child* was born with a rough and frightful *Head*, and the *Feet* of a *Gooſe*.

VI. *There might poſſibly be a foundation of Monſters from the beginning.*

Of all theſe ſtrange *Births* various cauſes may be aſſigned: For in the firſt place, we may without offence believe that the firſt *Seed-plot* of *Monſters* as well as of perfect *Creatures*, was planted in the beginning, and that *Generation* only conduces to render them capable of a ſenſible growth; nor doth it avail to ſay, that *GOD* cannot be the Author of *Monſters*, for he would be ſo nevertheleſs, tho' the firſt *Seed-plot* of *Monſters* were not till after the beginning; and there is a ready anſwer, *viz.* That there is nothing in the *World* except *Immorality*, of which *GOD* is not the *Author*.

VII. *Or ſome Cauſe may be in the Conception.*

2dly, The cauſe of any *Monſtrous* defect is either in the *Conception*, or the *Egg*, in which ſome paſſages are by accident obſtructed, or ſome *Fibres* pluckt off; or in the *Womb*, when the *Placenta*, into which the *Male Stock* is ingraffed, hath ſuffered any defect; or in the deciſion of the *Conception*, or laſt efflorescence.

VIII. *Or from the ſtreightneſs of the Womb.*

3dly, Theſe *Monſtrous Bodies* may poſſibly proceed from the ſtreightneſs of the *Womb*, whence HIPPOCRATES compares an over-ſtreight *Womb* to a ſtony place, which cauſes the *Tree* that ſprings up there, to become bent or diſmembred; or to the narrow Neck of a *Veſſel* which ſtifles the growth of the *Cucumber* when tender, and contracts and curtails it when growing to maturity.

IX. *Or from the Imagination.*

4ly. The force of *Imagination* may produce a defect, or exorbitancy in the *Birth*, as we oft ſee *Warts* and *Spots* impreſt upon the *Birth* by *Imagination*; and theſe *Spots* are not always the ſimple reſemblances of *Cherries*, *Mulberries*, but alſo ſometimes of *Entrails*, as *Liver*, *Heart*, &c. Now if this *Imagination* have ſuch a power upon one part, why may it not have the like upon many, nay upon all?

X. *How Twins come to be born with Bodies joined or faſtned to each other.*

Animals which bear *Twins*, ſometimes bring forth *Monſtrous Births*. So we ſee may times out of one and the ſame *Egg*, a double *Monſter* produc'd, a *Chicken* with four *Wings* and as many *Feet*, and ſometimes with two *Heads*. *Twins* oft-times are born with their two Bodies joined together into one; as at *Conſtance*, near a place called *Abronium*, there were born two *Children*, Male and Female, with two Heads, four Arms, and as many Feet, that is, each of them had all their Members compleat, only they were joined together about the *Navil*.

The Reaſon ſeems to be, becauſe altho' *Twins* in moſt *Animals* are wrapt up in the ſame *Membran*, called *Chorion*, yet each of the *Births* hath its proper *Membran*, called *Amnion*, and therein a ſeparate Conception; yet ſometimes it happens that theſe two *Membrans*, mix as it were into one, or at laſt mutually interſect each other, whence certainly ariſes a great confuſion of parts, for this

the *Fibres* and the *Canals* have proper to themselves, *viz.* that they easily join into a Contexture; so there is not a total confusion of the Colliquaments, but only some commixture and compression which will cause the two *Twins*, thus united together, to have some parts in common; and the Colliquament, upon the consumption of one of the salient points, to turn into a duplicated *Animal*, and consequently some *Members* will prove superfluous. The same thing happens in *Fruits*, if they be crowded up in straight places before they arrive to their due magnitude, as hath been already hinted, tho' *Plants* seldom undergo this sort of failures and lapses of *Nature*, because they are more plain and simple, and the *Organs* of their *Body* are lesser and less exact; so that in their constitution they give *Generating Nature* less occasion to err. For it is very obvious to err in composing *works* of divers parts join'd each to other with most curious Artifice, as the *Members* of *Animals* are. Whence it appears, that *Mothers* consult very ill for themselves and *Children*, while they live idely and lasily at home, and incommode the *Child* within them, while they sit double or cross-leg'd at their *Needle-work*. Forasmuch as by this overmuch contraction, they bring *Children* into the *World* Bunch-Backt, Splay-Footed, Crooked or Awry, or some way or other Mishapen.

XI. *How Africa comes chiefly to abound in Monsters.*

Sometimes also *Monsters* are produc'd from the various commixture of divers *Seeds*, that is, when the sorts of *Seeds* are taken in at several times one before, another after. Hence it is that *Africa* is generally said to abound in *Monsters*, because *Animals* of different kind resort from all parts of the *Country* to drink of what *Streams* of *Fresh Water* they can find, which are fewer than in any other quarter of the *World*; and so rencountring each other, they couple promiscuously together, and bring forth productions never intended by *Nature*.

XII. *How it may be known whether Monsters, having double parts, be two Animals, or but one.*

The next thing to be considered is, whether *Monsters* that have double *parts*, can be said to be two *Animals* or one. To determine this the better, it is to be supposed, that the *Heart* is the principal part of every *Animal*; forasmuch as all other parts derive their original from it; so that if there be two *Hearts* in any *Animal*, it will necessarily follow that the *Animal* possessing those two *Hearts* is a double *Animal*. For as it is the principle of the *Operations* of the *sensitive Soul*, according to the *Internal Senses*, and in part according to the motions of the *Appetite*; so it is vulgarly said to be the *principle* of the *Vegetative* and *sensitive Soul*, according to the *motions* of the *Appetite*. Hereupon SENNERTUS infers, that that *Monstrous Birth* of *Emaus* having two *Heads* and two *Hearts*, was to be accounted two *Men*: But that the other born in the year 1531, who had two *Heads*, and but only one *Heart* and lived to *Mans Estate*, was to be reckned no more than but one *Man*, which he proved by this Argument *viz.* that the two *Heads* perpetually testified their consent to the same *actions*, had the same *appetite*, the same *hunger* and *thirst*, *spake* in the same *manner*, had the same *desire* to accompany with their *Wife*, the same *desire* to exonerate *Nature*. But in the other who had two *Hearts*, there was not found the same conspiracy and consent of *Affections* and *desires*; what this would have at one time, the other affected at another time; sometimes they agreed, sometimes they squabled.

XIII. *Monstrous Births in other Animals besides Mankind.*

Monstrous Births proceed not only from *Mankind*, but also from other *Animals*; forasmuch as being equally endued with *Corporeal Imagination*, they may be as eagerly intent in the beholding of any *Object*, and by this means may induce various Forms upon their *Births*. So *Jacob* made a great part of his Unkle *Labans Flock* his own, by the *ringstreaked* and variously *spotted Rods* he cast before the *Ews* when they were ready to conceive: Thus we draw fine *Pictures* upon the *Wings* and *Tails* of divers sorts of *Birds*; thus we produce delicate breeds of *Dogs* and *Horses* curiously streakt and *spotted*; and who knows but that that wonderfully shapt *Monster* described by FINCELIUS might be produced by this or some such like *artifice*; that *Monster*, I say, which being calv'd by a *Cow*, had the Feet of a *Calf*, a *Mans Head*, with both Ears also like a *Man*, and Hair of an indifferent length, a Breast also and *Teats* on them like a Human *Creature*. Nor must the *Turky Hen* be past by, which had the Body of a *Peacock*, the Crest and Dewlap of a *Game Cock*, a Voice like that of the *Peacock*, and a noble display of Colours on the Tail; for such is the force and power of the imaginary, tho' corporeal *Faculty*, that when *Animals* behold any thing attentively, it makes so deep an impression in them, that they impart those *impressions* of various *forms* upon their *Births*.

XIV. *But most in Mankind.*

But there are more differences and varieties in *Man* than in other *Creatures*, by reason that swiftness of *Thought*, readiness of *Mind* and variety of *Fancy* and *Ingenuity* makes impressions of various *forms*, whereas other *Creatures*, have for the most part the same reception of *Images* which are produc'd from the variety of *Tracts* impress in the *Brain*, whereby it comes to pass, that a *Womans Imagination* induces a strange and borrowed Form and Image, no way like to the begetter, but totally differing from them.

XV. *Whence the deformity of some Bodies.*

Now upon serious reflection of all that hath been said on this *Subject*, there is nothing more odious and detestable to me, than to see wanton *Women* so excessively delight themselves with *Dogs* and *Apes*, as to carry them in their *Bosoms*, hug them, stroak them, and be continually handling and making much of them; since by this familiarity, and having these *Creatures* perpetually in their sight, the imperfect Nature of *Women* is apt to conceive in the *Mind* one or other strange *form* or *feature*, and so fix upon the *Birth* a Face like some of those *Animals* they converse with, or at least some way or other specially illfavoured. Yea, sometimes *Children* are brought into the *world* with odd kind of *shap'd Bodies*, Visages out of the common road of *Human Aspect*, distorted *Mouths* and *Cheeks*, inflate like the *Picture* of the *North-wind*, and all by the *Mothers* regards continually and intently fixt upon brutal and unwonted *Objects*.

CHAP.

CHAP. IV.

Of the Birth of Animals.

I. *Why Women bring forth but one Child at a Birth.*

Women lie in commonly but of one *Child*, whereas other *Creatures* bring forth many of their kind at a *Birth*.

This is, becauſe in thoſe *Animals* there are divers *Cells* or *Fleſhy Eminences*, to which ſmall *Eggs* are faſtned, one to each: But it is not ſo with *Women*, for tho' the *Virile Seed* aſcends in *vapors* to the *Teſticles* through the *Tubes* of the *Matrice*; yet notwithſtanding *Women* do not commonly conceive two *Children*, by reaſon that the *Womb* hath but one Cavity; and that for the accompliſhing of *Generation*, it is not enough that it be receiv'd into *Teſticles*, but it muſt alſo be received into the *pores* of the *Eggs* to cauſe them to ferment; nor can theſe *pores* receive it till after the *Egg* is brought to a certain point of maturity, to which commonly, in *Women*, they attain not to, but only one after another; as we ſee in the *Ovaries* of *Hens*, whence the *Eggs* for the moſt part are not unfaſtned but ſucceſſively. We muſt therefore ſuppoſe that when *Women* bring forth two *Children* at once, it either proceeds from hence, namely that two *Eggs* fall at one and the ſame time into the *Womb*, and that there are two places for them to be faſtned to, and for that the two *Eggs* have been in ſuch ſort formed in the firſt *Creation* as to be apt to faſten to the ſame *Placenta*.

II. *Whether there be any ſign to diſcover whether a Woman ſhall have Twins or not.*

There are ſome who brag that by a certain ſign or mark, they can eaſily gueſs whether a *Big-bellied Woman* ſhall have Twins or not.

But their boaſt is vain and groundleſs, for of this matter there can be no certainty, rule or knowledge. It can neither be the big ſwelling of the *Belly*, which ſometimes is greater in the bearing of a ſingle *Birth*, than in that of *Twins*; nor the diverſity of *motions*, which many times ſome have taken ſuch ſtrict obſervation of from an abortive *Embrio* only, eſpecially by the ſlow motion thereof, as to believe that the *VVoman* would certainly have had *Twins*, had ſhe gone out her time. Nor an *external Line* dividing the *VVomb* in the middle, which ſeveral *Anatomiſts* have, even from their own Wives, found experimentally to be a vain conceit: Nor the ſwelling of their *Legs* and *Feet* in the laſt Month, or Months of their going with *Child*, ſince they ſwell in that manner, even in the bearing of ſingle *Births*: Nor laſtly, the large diſtenſion of the *Belly* towards the Sides, which the various ſituation of a ſingle *Birth* may be the cauſe of. *Rebecca* indeed from the extraordinary motion of two *Embrio's* ſtrugling one againſt the other, gueſt that ſhe had *Twins* within her; but this might alſo be partly a Divine Inſtinct.

III. *What the Cauſe is of Abortion in Women.*

VVomen oftentimes happen to bring forth an *Immature Birth*, and to ſuffer an Efflux or Abortion before the due time appointed by *Nature* for their Delivery. *Abortion*, or the untimely Excluſion of a *Birth*, not yet perfected, happens according to the opinion of the *Galeniſts*, either from the overmuch abundance of *Blood*, by reaſon of the great afflux thereof to the *VVomb*, more at that time than another; or elſe from the want of *Blood* in the *Mother* to nouriſh the *Infant*. But in my Judgment there are ſeveral Cauſes to be enquired into, as well relating to the *Mother*, as to the *Birth*. On the of the *Birth*, *Abortion* happens when the *Uterine Glands* are ſo infirm, that they are ſoon broken; or the *Membrans* ſo thin, as upon the leaſt occaſion to burſt; upon which the humours breaking forth, the *Birth* decays. On the part of the *Childing VVoman*, if ſhe be of a weaker Nature than ordinary, and hath not ſtrength ſufficient for the bearing of ſuch a burthen: Sometimes it happens from a ſuddain *fright*, or the *noxious temperament* of the *Air*. To which purpoſe AELIAN relates, that *VVomen* inhabiting the *Southern Countries* are more ſubject to *Abortion* than thoſe that live more *Northerly*, becauſe there the *Limbs* are more ſupple; and thoſe parts which conduce to *Childbearing* are more looſened.

IV. *When Abortive Births uſe to happen.*

An *Abortion* may happen from the firſt moment of *Conception* to the beginning of the ſeventh Month; but it is moſt frequent about the end of the third: not but there have been examples thereof both before and after that time. Before the tenth Week after *Conception*, excluſions are ſcarcely taken for a real *Abortion*, becauſe till after that time ſcarce any rudiment of a *Birth* appears; ſo that it is then rather accounted for a *Mole*. For unleſs the *Birth* appears in the body of the *Placenta*, it is not allowed to be a true *Conception*, and conſequently the excluſion thereof cannot be ſaid to be an *Abortion*.

V. *Why Infants are born at nine Months end.*

The end of nine Months is the uſual time of an *Infants* coming into the *world*.

The Reaſon of this is, partly becauſe of the overmuch Meconium of the Inteſtins made by the *excrements*, which is nothing elſe but the mixture of *Phlegm*, *Choler* and *Pancreatick Juice*, which becauſe of overmuch delay, become overſharp, whence by a troubleſom vellication of the *Fibres* of the *Inteſtins*, it cauſes an influx of the *Animal Spirits* into all parts, and ſo the *Birth* overmuch ſtirring it ſelf by its calcitration or kicking, breaks the two *Membrans*, the *Amnion* and the *Chorion*, in which it is wrapt, and gathering it ſelf round, ſhoots downward towards the *internal Orifice* of the *VVomb*, which by dilating, it naturally makes its way into the *world*.

VI. *The Viper does not let out her young ones through her diſſected Sides.*

The *Viper* brings not forth but with the loſs of *Life*, for on the third day ſhutting in her young ones into her *VVomb*, having about twenty to bring forth, and having brought one a day for two or three days before, the reſt impatient of their ſlow Birth, and haſtning into the *Light*, bite through the Sides of their *Dam*, and thereby open a gap to their own Life and her death. Whence *Mantuan*;

The Viper wounded by the fatal bite
Of the young Vipers, dies to give them light.

This Tradition, from the Age of *Herodotus* to this very time, hath been received for an undoubted *Truth*, namely, that the *Male Viper* loſes its Life in the midſt of *Copulation*, by thruſting its Head into the Mouth of the *Female*, who through the height of pleaſure bites it off: As alſo that the young ones not tarrying their time, make a ſpeedier way by tearing the *VVomb*, and gnawing through the *Breaſt* of the *Dam*. But the vanity of this aſſertion they find by experience, who preſerve them in *Glaſs Veſſels* for their uſe, in certain *Medicinal*

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Compoſitions. It may well enough be conjectur'd that this fancy took its original from hence, namely, becauſe *Vipers* are brought forth fenc'd about with their *Membrans*, which in regard ſome of them break not till the third day after their being brought forth, and others free themſelves of them in the *VVomb*; hereupon ſome have taken the *Membran* for the *VVomb*, and delivered in writing that the Brood of *Vipers* gnaw through the ſides of the *Dam*, and by that corroſion cauſe her Death.

VII. *But the Fiſh* Acus. But this is known for a certain, that the Belly of the *Fiſh* called *Acus*, in the midſt of her *breeding*, cleaves into a gaping Aperture by reaſon of the multitude of young ones within her, which cleft is not effected by the corroſion or gnawing of the young Fry, but by the rupture of the Skin making a gap under the bottom of its Belly, by which, contrary to the cuſtom of other *Fiſh*, its *VVomb* is extended in time of breeding, and in which it lays up its *Spawn*. For RONDELETIUS upon his own experience atteſts, that as he was diſſecting of one of this ſort of *Fiſh*, he found abundance of *Spawn* in that very gap; and likewiſe that as he was inſpecting into the ſaid *gap*, he found in two other leſſer ones, ſome *Spawn* newly hatch'd, and many Births juſt perfected; whereof ſome of the biggeſt moved, but others imperfect, whoſe Eyes and Mouths were only to be perceived. From all which it may be gathered, that the *Fiſh Acus* does not ſo much bring forth young ones, as exclude them out of that burſted Gap, and that the *Viper* ſuffers no damage by the production of her *Viperous Blood*.

VIII. *How it comes that Animals have each their ſet ſeaſon of bringing forth from the time of Copulation.* *Animals* obſerve each of them, their certain and determinate time in bringing forth. *Elephants* go go 2 years, *Mares* 11 Months, *Camels* 12 Months, *Cows* 10, *Sheep* 5, *Bitches* 9 Weeks. *Birds* alſo lay their *Eggs* at a ſet time from the *Seed* received. *Women* alſo have their ninth or tenth Month for their delivery, which if they exceed, the *Birth* is accounted either not Natural, or not Legitimate.

There is one common Cauſe of all theſe different *Seaſons*, namely, for that the *Birth* as it grows bigger and bigger, being more and more unſatisfied with its nouriſhment, makes a ſtir and eagerly indeavours to enlarge its Commons, and provide it ſelf with a more plentiful ſubſiſtence; as alſo for that being ſhut up in too narrow a compaſs, and ſtreightned by the *Membrans* wherein it is wrapt, it ſhakes the Walls of its Priſon to get free. And this is to be obſerved, not only in *Animals* of the bigger ſort, and *viviparous* or live-bearing, but alſo in the *Oviparous* or Egg-bearing. For a *Chicken* ſhut up in its *Egg*, as ſoon as the *Yolk* upon which it hath lived is conſumed, with the help of its *Dam*, the *Hen*, breaks the *Shell* and gets its liberty. Thus the *Egg*, after *formation* compleated, becomes ſo burdenſom to the *Womb*, that being in a ſort exaſperated, indeavours to expel the ſaid *Egg*, and to free it ſelf from ſo troubleſom a burthen.

IX. *Why Animals are born with their Head downward.* All *Creatures*, if they are brought forth according to *Nature*, are carried inverſe, and prone upon the Head, open the Mouth of the *Womb*.

The Reaſon is, becauſe that part of the *Body*, from the *Navel* upwards, to the *Head*, is more ponderous than that which from the *Navel* reaches downward; and ſince heavy things tend to the lower parts, the *Head* of the *Infant* muſt of neceſſity be carried firſt to the *Orifice* of the *Womb*. As of two *Skales* of a *Ballance*, the heavier tends downward, and the other upward. And if at any time it happens otherwiſe, that *Birth* is ſaid to be not Natural, but as it were perverting the courſe of *Nature*; as when it comes out with its *Feet* forward, or with one *Foot* ſtretcht out, another tending to one ſide; or when with one or both *Hands* it offers it ſelf to the Mouth of the *Womb*.

X. *Why Infants born in the 7th Month live, and not thoſe born in the 8th.* Ancient *Phyſitians* are of opinion, that a *Septimeſtrian-Birth*, or a *Child born* in the ſeventh Month may live, but that an *Octimeſtrian* or Eight-month Birth is for the moſt part fatal.

The Cauſe hereof HIPPOCATES attributes to the order of the ſeven *Planets*, that preſide over *Human Affairs*, and have their domination or Government over them, each in their turn. So that according to his aſſertion, the firſt Month belongs to *Saturn*, the ſecond to *Jupiter*, and ſo of the reſt, till the dominion comes to *Mercury*, who is the loweſt of the *Planets*; which Circuit, being finiſh'd, it returns again to *Saturn*. But how comes *Hippocrates* to underſtand ſo well this power of the wandring *Stars*? Wherein is it that this great force of theirs conſiſts? What Inſtruments guide them to the *Infant* wrapt up in his *Membrans*? But looking upon theſe things as the *Dreams* of a wiſe or rather induſtrious Perſon, I chooſe to adhere to PLINY, who affirms the contrary to have hapned in *Ægypt*, in which Country he ſaith, there is nothing more frequent than for *Octomeſtrian Births* to live, and brings for example, *Cæſonia*, the Wife of the Emperor *Caius*, who came into World in the eighth Month. This account is confirmed by CARDANUS, bringing an inſtance of Cardinal *Sfondano* and others, who being born in the eighth Month, nevertheleſs lived to a very conſiderable Age. And what ſhould hinder us from aſſerting, that Perſons born in the eighth Month are more long liv'd than others; ſince it is a great Argument of vigor that they anticipate the ordinary courſe of Nature, and as it were take it in dudgeon to be ſhut up longer in a Priſon, unleſs the blame be laid upon the *Mothers* weakneſs, and the *Birth* be accelerated by an overmuch irritation of the *Womb*.

XI. *How Infants are ſaid to be born in the 12th or 13th Month.* It is delivered by ſome *Phyſitians*, as well Ancient as Modern, that there are *Births* of eleven Months: PLINY makes relation in his *ſeventh Book*, *Chap.* 5. of a *Woman* who was brought to Bed in her thirteenth Month; and AVICEN writes of another that was delivered in her tenth Month.

This *Computation* may poſſibly have hapned from the roguery of ſome *Women*, and the ſimplicity of others in miſreckning their time: *Roguery* when a *Woman* having no *Children* at her *Husbands death*, may for enjoyment of his *Inheritance*, and *Perſonal Eſtate*, accompany with another Perſon, and have a *Child* by him within 11, 12, 13, or 14 Months, and ſo lay the getting of it to her deceaſed *Husband*; which kind of Villany is ſo common, that all the World over in all *Judicial Courts* ring of it. And this is the reaſon that theſe late kind of Births are ſeldom heard of except in ſuch ſort of *Widows*, but very rarely in

in those *Women* whose *Husbands* live, and constantly Bed with them. But as to the misreckning, *VVomen* generally compute the beginning of their *Conception* from the first stoppage of their *Courses*, whereas it may possibly fall out, that for some other cause they may stop two or three Months before *Conception*; so that if a *VVoman* begins the *computation* of her being with *Child*, the very first time of their *Stoppage*, she must needs be in an error, and by reason thereof it will be thought that the *Infant* came into the World on the *11th* or 12 Month, when indeed it was born after the wonted manner, at the end of the *9th* Month.

XII. *Why Infants kick a little before their Birth.*

A Great *Birth*, when Mature, for the most part kicks, and gathering it self up in a heap, breaks the *Membrans* in which 'tis wrapt.

This *Kicking* proceeds from a necessity of refreshment or respiration; for the heat of the *Embrio* is small at the beginning, and setting it self at first to shoot out like a small sparkle, it hath then no need of refreshment, but augmentation; but as the bulk encreases by little and little, so also the *Actions* and *Motions* of the *Birth* encrease. But at length the heat is so encreased, that then it chiefly wants ventilation and refrigeration, which not being found, the *Birth* begins by little and little to be more and more disturbed, and by reason of that disturbance and anxiety, to stir and kick at length so much the more strongly, and by that strong motion to incite the *Uterine Vapors* to a violent Effervescence or boiling, and thereby to endeavour to make its passage out into a freer *Air*.

XIII. *Why the Milk encreases in the Breasts the fourth day after Childbearing.*

Womens Breasts immediately after their delivery, swell and abound with *Milk*, but especially on the *3d*, *4th* or *5th* day.

That is, because Childbed Women the three or four first days after *delivery*, seldom bend their Minds intently upon any business, or serious affairs, and thereupon having but very little appetite, they eat and drink less than usual, and breed less Chyle; but in the following days they eat more, and the *Infant* begins to cry more, and then they presently begin to think of Nutriment for the *Child*, and desire to quiet it from crying. From which affection the passages being loosned by a determinate influx of *Animal Spirits*, which before were carried to the *VVomb*, the *Chylie Juice* is then converted to the *Breasts*.

XIV. *Imagination impells the Chyle to the Breasts.*

And this their strong intent and frequent rumination about their *Milk*, and the *suckling* of their *Young Ones*, may possibly cause the *Chyle* to be the better conveyed to the *Breasts*: Which most evidently appears from what SANTORELLUS relates of a *Man*, who after the *death* of his *VVife*, not being able to hire a *Nurse*, one time above the rest, to still the *Child*, when it cryed, took it to his *Breast*, and gave it the *Dug*, doubtless with great desire of satisfying its Appetite with *Milk*: and by this iterated application, together with an earnest intention of Mind, and the *Childs* sucking of the *Teat* from time to time, the *Chyliferous Passages* were opened, and the *Paps* afforded plenty enough of *Milk* for the *Childs* nourishment. Thus *Imagination*, and great apprehension of Danger, sometimes causes a *Man* to tremble, to be in a cold sweat, to fall into a swoon and the like.

Infants that *suck* the *Milk* of a *VVoman* with *Child*, become sick and weakly, and many times contract dangerous *Diseases*, as we see in too many, who by reason of the *Nurses* avarice, get a sickly habit, which shortens their days, and never ends but with their Lives.

XV. *Children sucking the Breasts of a Woman with Child, contract Diseases.*

The Reason is, because the sweetest and grossest portion of the *Alimentary Liquor* is attracted by the *Birth*, and nothing but what is serous, and tainted with excrementitious depravity is carried up to the *Paps*. For tho' the said *Paps*, as HIPPOCRATES affirms, are rendred so much the larger, by how much they attract any thing of *Fat* from the *Belly*; yet in regard before *Childbirth*, the passages are too narrow for the fatter and sweeter parts of the *Milk* to pass through; therefore nothing but what is serous and most hurtful to the *Infant*, can get up to the *Paps*.

XVI. *The occason of a Womans bringing forth a dead Child.*

A *VVoman*, within the verge of our memory, upon the sight of the *Naked Arm* of a lusty well-flesh'd *Man*, longed to eat some of it, and the Honest Man in pity to her Condition, and to satisfie her extravagant Appetite, permitted her to bite thereof: But upon her second longing he thought it too much to sacrifice his *Arm* to her ill-govern'd Appetite, and made bold to deny her; whereupon the unhappy *VVoman*, who doubtless could not help her irregular desire, overcome with trouble, fell in Labour.

Of this there can be no other Reason, than for that the *VVomans Heart*, having contracted a deep *sorrow*, the *vital Spirits* were diminish'd, and the Humours design'd for the nourishment of the *Child*, averted another way, and not conveyed as at other times to the *Womb*. So that the *Infant* destitute of that *Aliment*, wherewith the *Mother* would have had it satisfied, languish'd and at length died. For the Passages and Conveyances by which sustenance used to be conducted into the *Womb*, being shut, the *Infant* must be destitute of *Nutriment*, and so deprived of *Life*.

XVII. *How the marks of a Woman stabb'd with a Dagger were impress upon the Child in the Womb.*

A certain *VVoman* in *France*, being stabb'd with a *Dagger*, an *Embrio* was taken out of her *Body*, mark'd with as many livid spots as she had received stabs, and in the very same parts of the *Body*.

The Reason is, because the *Embrio*, carried in the *Mothers VVomb*, makes up but one Body with the *Mother*; and as it is nourish'd with the same sort of *Aliment*, so it is vegetated with the same *Spirits* according to all its parts. Wherefore no wonder if so tender a *Body* as that of the *Embrio* is subject to the same *accidents* as the *Body* of the *Mother* is subject; and any *Mark* or *Brand* whatsoever is the more easily impress upon it, in regard the *Animal Spirits*, which convey the conceived *Image*, are directed by the *Mother*, whilst she touches any part of the *Childs Body*, and as it were marks it out.

CHAP. V.

Of Hunger and Thirst.

I. *How all Animals at one time or other come to be afflicted with hunger and thirst.*

ALL sorts of *Animals* are some way or other, or at some time or other pinch'd with hunger; and if we should except the *Chamelion*, which is said neither to *eat* nor *drink*, there are at least none besides which feel not a *vellication* of the

Stomach, and have not ſometimes dry and juiceleſs *Jaws*.

II. *That the Chamelion lives not upon the Air alone.*

Before we come to diſcuſs the Reaſon of this Affection in *Animals*, it will not be amiſs to premiſe ſomething concerning the falſity of this Old Tradition, *viz.* that *Chamelions* live only by the *Air*, ſince it is well known by experience, that they greedily receive as for a great delicacy a ſort of little Worms pick'd out of *Meal-troughs*, and that they make uſe of a *Proboſcis* inſtead of a *Tongue*, which they manage like a Dart, with ſuch incredible ſpeed, as not to be diſcerned by the *Eye* of *Man*.

III. *Whence Hunger in Animals proceeds.*

The Reaſon of that trouble and pain cauſed by *Hunger*, is the great plenty of a certain *Acid Liquor* flowing into the *Stomach*, which *Liquor* being conveyed from the *Heart* through the *Arteries*, inſinuates it ſelf among the *particles* of the *chew'd Meats*, and by diluting them, compoſes the *Chyle*. But when this *humour* finds nothing of *Meat* in the *Stomach* to be diluted, it exerts all its force into the *Membranules*, whereof the *Stomach* conſiſts, and agitates the *Nerves*, whoſe Extremities adhere to the ſaid *Membranules*, in ſuch ſort as is required to the cauſing of the ſenſe of *Hunger*: Whence no wonder if the *Stomach* being empty, and the *Meats* conſumed by the *Native Heat*, *Hunger* ſucceeds with a gnawing of the *Belly* which attends it. In like manner, all *Creatures* are affected with a deſire of quenching their *Thirſt* by *Drink*, whilſt the ſerous part of the *Blood*, which is accuſtomed to take its courſe to the *Stomach* and *Throat*, under the ſpecies of *water*, thereby to moiſten thoſe parts, ſometimes alſo repairs thither in *Vapor*, and ſo dries the *Throat* and the *VVind-pipe*, and at the ſame time moves the *Nerves* in ſuch a manner as is required to excite a deſire of *drinking*.

IV. *Why great drinkers of Wine and Strong Liquors are little Eaters.*

Hence thoſe that are great *Drinkers* of *VVine*, *Brandy*, or any kind of *Strong Liquors*, more or leſs loſe their *Appetite* to *Meat*; in regard the ſaid *VVine* or *Brandy*, being full of *Volatile Salt*, cauſe the ferment of the *Stomach* to be either too *volatile*, ſo as that over-running the moſt ſubtle *pores* thereof, it leaves the *Stomach* deſtitute of all Incitement or Provocation, which produces *Hunger*, or at leaſt takes away that correſpondence that ought to be between the *Salt* and that *Acid Ferment* which is required in the *Stomach* to excite *Appetite*.

V. *How Sparrows come to be ſo voracious.*

VAN HELMONT is of opinion, that *Sparrows* are therefore ſo very voracious and deſirous of *Meat*, as having much of acidity in the *Throat*, and the *Stomach* irritated with ſome pungent *Liquor*. Hence the moſt dry and juiceleſs *Meats* are commonly eaten with ſome or other *Acid Liquor* or *Pungent Sauce*, as *Vinegar*, *Limon-juice*, *Pepper*, *Olives*, *Capers*, *Muſtard*, &c. to ſtir up an *Appetite*, ſo far as they are capable of helping the foreſaid vellication of the *Acid Juice* by their own proper acidity. But all kind of *Fat Meats*, *Broths*, or *Fat Soops* ſoon ſatisfie *hunger*, by glutting the *Stomach*, in regard the foreſaid acidity of the *Vellicant Juice*, being as it were drowned in thoſe ſort of *Glutinous Bodies*, gives not that provocation before-mentioned to the *Stomach*.

VI. *Not the heat of the Stomach, but the Acid Juice performs the Concoction of Meats.*

By this we may eaſily ſee into the error of Ancient *Phyſitians*, who attribute the Concoction of *Meats* to the heat of the *Stomach*; and imagined that the alteration of them was the effect of ſome extraordinary æſtuation. Foraſmuch as if we ſhould take ſome certain *Bones* of a *Sheep* or other *Animal*, and caſt ſome of them into a *Kettle* of *water* ſeething over a great *Fire*, and throw the reſt to a *Dog* to be devoured; it will appear plainly to the *Eye*, that thoſe in the *water*, tho' boyling never ſo fiercely for ſome hours, have ſuffered no diminution, but thoſe eaten by the *Dog* will be found upon the diſſection of his *Stomach* three or four hours after, allmoſt wholly converted into *Chyle*; whereas it would happen quite contrary, were the *Concoction* of *Meats* performed by *heat* alone, ſince no Man can make any doubt, but that the heat of the *Kettle* vaſtly exceeds that of the *Dogs Stomach*.

VII. *How it is that Meat received into the Stomach, turns white.*

Meat conveyed into the *Stomach*, and converted into *Chyle*, turns white like *Milk*.

This *whiteneſs* of the *Chyle* is effected, not by any aſſimilating faculty, as *Phyſitians* have all along, and ſtill do commonly fancy, but by an action wholly *mechanick*; for as we ſee in an *Apothecaries Shop*, that many times *Fat* and *Oily Ingredients*, mixt with *Watry*, turn of a *whitiſh Colour*: So likewiſe in our *Stomach*, the Eſſence of the *Aliments* extracted, ſeems to us of an *Oily* or *Fatty Subſtance*, as the *drink* reſembles *water*. So that no wonder, if from the mixture of theſe two, there ariſeth a *whitiſh* and *Milk-like Colour*, which is the reaſon that the *Chyle* is always white. And as in the mixture of *Oil* and *Water*, a little *Sugar*, which is a ſpecies of *Salt*, is required to make them mix the more eaſily; ſo alſo in what we generally take in for ſuſtenance, a great deal of *Salt* is ſuppoſed to be.

Or to ſpeak more like a *Chymiſt*, it may be ſaid that this Colour proceeds from a *Sulphureous Matter*: That is, it ariſes from *Sulphureous* diſſolved together with *Saline Particles*, mixt with an *Acid Ferment*; for we find by daily experience, that if an *Acid Humour* be infuſed into a liquor impregnated with *Salt* or *Sulphur*, a white Colour is hereby immediately produc'd. As appears in the *Spirit* of *Harts-horn*, or *Soot*, imbibing a ſufficient quantity of *Volatil Salt*, which being incorporated with an *Acid Liquor*, obtains a *whitiſh Colour*, and very near reſemblance of *Milk*.

VIII. *Perſons ſick of a Fever are the more difficultly cured if great Eaters.*

Of *Perſons* that lie ſick of a *Fever*, thoſe are moſt difficultly cured who are great *Eaters*, eſpecially thoſe, who by virtue of their diſtemper, become more vorations than before. Hence *Phyſitians* obſerve, that thoſe *Fevers* are more laſting, by which Mens *Appetites* are increaſed, but thoſe which excite *Thirſt*, ſhorter.

The Reaſon is, becauſe thirſty people are more eaſily ſatisfied by the taking down of *Liquor*, which breathing out of the Body by Sweat, leaves nothing behind to nouriſh the *Fever*: But thoſe whoſe *Fever* is inflamed by an *Acid* and *Salt Humour*, as being over-greedy of *Meat*, load and ſurcharge the *Stomach*, and ſo nouriſh the *Diſeaſe*. The appetite of *Meats* is irregular, and affects us not always in the ſame manner.

IX. *How it comes that ſome are tormented with unquenchable Thirſt.*

Some are ſo exceſſively oppreſt with *Thirſt*, that all they can *drink* is not able to quench it.

The Cauſe of this exceſſive *Thirſt* in the *Mouth* of *Sick Perſons* is obvious; namely, when the *Salival Veſſels* are ſo obſtructed, that they cannot diſcharge their moiſture into the *Mouth*; where-

whereupon the *Mouth* being exceſſively dry, and parch'd, exceſſive *thirſt* muſt needs follow. Nor can it be removed, how much *Liquor* ſoever is pour'd in, ſo long as that obſtruction of the *veſſels* laſts.

Another Cauſe of *Thirſt* is, when *Moiſture* only is wanting in the *Blood*; but this *Thirſt* may eaſily be expelled by a large draught of *Drink*, by reaſon that in this caſe the *veſſels* are open enough. Now when the *veſſels* are obſtructed, to remove that obſtruction, *opening Gargariſms* are to be uſed, that is, ſuch as are compoſed of *Lapis Prunella*, and other *Nitrous Medicaments*.

X. *How it comes that ſometimes Perſons, well in health, have little or no appetite to their Meat.*

It oft happens that perſons who are very well in *health*, eat indifferently, and with little or no appetite, and can remain a long time faſting without any pain or trouble. *Roger Bacon* makes mention of a certain *Maid* that *eat* nothing for the ſpace of twenty years; as alſo of a *French Prieſt*, who in the time of Pope *Nicolas* the 5*th*, lived two years without any manner of *Meat* or *Drink*.

The want of *Appetite* may proceed from ſeveral Cauſes, ſometimes from Obſtructions, that is, when the *Acid Liquor* that provokes *Hunger*, is obſtructed, and denied all acceſs to the *Ventricle* or *Stomach*: Sometimes from cold and glutinous *Humours*, by which its vigor is weakned and hindred from exerciſing any power upon the *Membramules*: Sometimes from the corrupt temperament of the *Blood*, whereby the foreſaid *Juice* impelled from the *Arteries* into the *Stomach*, degenerates and becomes of a different nature from what it uſes to be; or becauſe the *Juice* or *Ferment* of the *Stomach* hath been thrown out by *purgatives*; whence the *Nervous Fibrils* are no longer provoked; or becauſe the Heat or Flame (as *Phyſitians* call it) of the *Heart*, is agitated but with a gentle motion, and thereupon conſumes but a ſmall quantity of *Blood*; as we ſee commonly in *Maids* troubled with the *Green Sickneſs*, who being taken with an *Anorexie* or want of *Appetite*, have wholly abſtained from all ſorts of *Meats* for a conſiderable time, and without much falling away of the *Body*.

XI. *Hunger proceeds not from any liquor in the Milt.*

For I cannot aſſent to thoſe who will have it, that *Hunger* proceeds from a Liquor flowing out of the *Milt*, ſince there is a ſhort Ligature of the *Venous Veſſel* between the *Stomach* and the *Milt*, which by its intumeſcence or riſing up in a *living Animal*, hinders any thing from paſſing out of the *Milt* into the *Stomach*, as appears from thoſe *Valvulæ* which are in the ſaid *Venous Veſſel*; being ſo diſpoſed, that tho' any thing may have a paſſage from the *Stomach* into the *Milt*, yet from the *Milt* through any *Veins* into the *Stomach* it cannot paſs.

XII. *How a Maid could live ſeveral years without Meat or Drink.*

As to that *Engliſh Girl*, mentioned by *Roger Bacon*, who eat nothing for the ſpace of twenty years, it will prove a very difficult task to make out clearly the Cauſe of ſo long and continued an abſtinence from *Meat* and *Drink*, unleſs it be allowed, that from an extraordinary moiſtneſs of the *Brain*, a certain thin and pituitous matter flow'd down from the *Head* into the *Stomach*, which might poſſibly turn to *Nouriſhment* in the *Body*, as we ſee in *Dormice* and ſeveral other *Animals*, namely, *Bears* and *Brocks*, that paſs whole *Winters*, and receive no ſuſtenance from without, but are nouriſh'd only by their inward *Fat*. It may alſo be aſſerted, that the *Vital Flame*, and as *Philoſophers* vulgarly call it, *innate heat* in the aforeſaid *Green Sickneſs Girl*, moved ſlowly, and conſumed but a ſmall quantity of that Blood which turns to Nouriſhment in the Body.

XIII. *Hunger expelled by the taking of Tobacco.*

Hunger and *Appetite* is many times abated, and ſometimes expelled by the taking of *Tobacco*, as we ſee frequently among *Soldiers* and *Seamen*, who upon the taking of a *Pipe* of *Tobacco*, are often very well refreſh'd, and their *Hunger* ſatisfied.

The Reaſon hereof ſeems to be, that in the common ſort of *Tobacco*, being ſtrong and full body'd, there is much *Opium*, which keeps the *Blood* from being over *Acid*, and reſtrains the *Spirits* from flying away in too great a quantity: For herein *Hunger* and *Appetite* chiefly conſiſt, that the *Acid Humours* vellicate the *Nerves* of the *Stomach*; which *Acidity*, if it be drown'd and ſtifl'd in the *Viſcoſity* of the *Tobacco*, the *appetite* and *deſire* of *Meat* muſt of neceſſity ceaſe; and if by reaſon of the ſaid *Viſcoſity*, the *Acidity* of the whole *maſs* of *Blood* be blunted and impair'd, conſequently the fewer *Volatil Spirits* muſt be left; the loſs whereof will be attended by debility of *Body*, and at length by *death* it ſelf.

XIV. *Some are always hungry.*

Some there are who are ſcarce ever ſatisfied with *Eating*, but are ſtill ravening after more *Meat*; and ſuch are they who are ſaid to be affected with a *Canine Hunger* or *Appetite*. FRISCUS *Lib. Cap.* 7. makes mention of a *Woman* of a great Age, who was not able to live a moment longer than ſhe was eating. The Emperour *Maximus*, ſurnamed the *Thracian*, who ſucceeded *Alexander* the Son of *Mammæa*, had for his daily allowance a prodigious quantity of Meat and Drink.

This extraordinary *Voracity* may proceed from two Cauſes, firſt by reaſon of the *Acid Juice* in the *Stomach*, ſo exceſſively abounding, that tho' *Food* be never ſo faſt cramm'd in, yet it remains ſo acid and pungent, that it ſtill corrodes the *Stomach*, and continues a violent *Vellication*; and ſince the *Meat* in the *Stomach* is thereupon not diſſolv'd in ſuch a manner as it ought, the Mucilage thereof hapning for the moſt part to be corrupted, comes back at his *Mouth*, and is caſt off as unprofitable and ſuperfluous *Aliment*. 2*dly*, This unreaſonable deſire of *Meat* may proceed from *Worms* which ſwarm in the *Belly*, and ceaſe not to gnaw and feed upon it any longer than they are fed themſelves with freſh ſupply of Nutriment. And to this purpoſe there goes a ſtory of a certain *Woman*, who having voided a *Worm* of twelve inches long, return'd to her wonted moderation in *eating*; and likewiſe of another that did the ſame after ſhe had voided 100 little *Worms*.

XV. *How it comes to paſs that ſome perſons can live a long time without Hunger or Appetite*

There are ſome, who, for ſeveral days together, feel no *Hunger*, and remain faſting without any diſturbance of *Mind*.

The occaſion of this is, becauſe that Liquor which affects the *Membranules* with its acidity, is too dilute or weak to be capable of vellicating the *Stomach*, or becauſe at that time it may poſſibly be ſeparated from the purity of the *Blood*, or paſs away into Sweat, either by inſenſible *tranſpiration*, or by *urine*. And this confirms the ſtory of a certain Man, who being ſhut up under ground, and not able to get out for the ſpace of three weeks, kept himſelf alive all that time by drinking his own

own *water*: For whilſt he was ſo impriſoned, his *Blood* was leſs diminiſhed by inſenſible *tranſpiration*, than when he breathed in the free *Air* above ground.

XVI. *How it comes that Women with Child covet the eating of odd ſorts of Meats.*

Women with *Child*, eſpecially the firſt three Months, when they begin to be ſubject to their *Breeding Qualms*, delight to feed upon things of a ſtrange Nature, and unfit for *Human Food*. Some delight in *Tan'd Hides* or *Leather*; ſome can eat *Shreds* of *Woollen* or *Linnen*; others *Chalk*, *Tobacco Pipes*, *Cinders*, or the like.

The Reaſon of this ſtrange deprav'd *Appetite* is deduc'd from the Reaſon of *Hunger* it ſelf; for when the *Liquor* which proceeds from the *maſs* of *Blood*, continually takes its courſe through the extremities of the *Arteries* into the *Stomach*, it preys upon it, as hath been ſaid, for want of *Food*, by agitating more vehemently than uſual, the *Filaments* of its *Nerves*. But if the ſaid *Humour* be of that Nature as to exert its ability rather upon ſome *meats* than others, after the ſame manner as *Aqua-fortis* more eaſily diſſolves *Metal* than *Wax*; it thereupon affects the *Nerves* of the *Stomach* with ſome ſingular quality or other. Whence it comes to paſs that the *Soul* inclines to ſome ſorts of *Meat* rather than others, and at ſuch time as aforeſaid, moſt vehemently covets, what at another time it would loath.

XVII. *Why ſome that are great eaters, nevertheleſs are ſpare and lean.*

Some *Perſons*, tho' they *eat* much, yet are never the *fatter*, but always thin and *lean*: Others on the contrary, eating but little, grow very fat and corpulent.

The Reaſon is, becauſe ſome people conſiſt of a *Fibrous Blood*, and their *Fibres* are of a very ſoft and pliable contexture; ſo that by the acceſſion of new *Fibres*, their *Fleſh* muſt needs become inflate and looſened into a fat conſiſtence. Whereas thoſe that are *lean* have drier *Fibres*, and which conſiſt of a harder contexture; which being uncapable of acceſs or addition, cannot be augmented or dilated.

Another Reaſon is this, becauſe too great quantity of *Meats* devoured, cannot well be *fermented* or attenuated; whereupon there ariſes a thick and viſcous *Chyle*, which being conveyed to the *Lacteal Veins*, and by reaſon of its thickneſs not being able to paſs, is forced to ſtop, and this ſtoppage produces obſtructions, which hinder the *Chyle* from paſſing freely to the *Blood*. So that no wonder if ſome great *Eaters* are frequently leaner than thoſe of a ſparer and more ſlender *Diet*.

XVIII. *Why after Meat ſome feel more cold than before.*

It is a common obſervation, that many perſons are more cold than ordinary after *Meat*.

The followers of GALEN alledge for a reaſon, that the *heat* draws inward, and returns toward the *Heart*; but we rather aſſert, that the true reaſon of this cold is, becauſe the *cruder part* of the *Chyle* tranſmitted from the *Stomach* and *Inteſtines* through the *Lacteal Veſſels* to the *Blood*, diminiſhes in ſome ſort the rarefaction thereof in the *Heart*, and hinders the *Blood* from being carried with ſuch a force as it was wont, to the ſolid parts; whereupon the *Vapors* ariſing from thence into thoſe parts, meet ſome ſtop, and thereby the *Fibrils* ſuffer a tremour of the parts leſs than uſual, and herein conſiſts the reaſon of the *Cold*.

CHAP. VI.

Of the Motion of the Heart, and Circulation of the Blood.

I. *How Laughter comes to hinder the Motion of the Blood.*

PHyſitians obſerve, that *Reſpiration* is hindred by *Laughter*, and if it be exceſſive, that then the Motion of the *Heart*, and Circulation of the *Blood* is ſtop'd.

The Reaſon is, becauſe in *Laughter* the *Diaphragma* or *Midriff* ſeems to be driven by the *Muſcles* of the lowermoſt *Ventricle*, which preſs the *Entrals* upon it, upwards as far as the Cavity of the *Breaſt*, and with a tremulous progreſs to be relax'd or looſened, as it were to expel the Air by parts, for the forming of a *Laughter* within the *Larinx*, whereby it comes to paſs, that adhering to to the very *Pericardium*, it drives up the heart, and its *Baſis* cloſe to its *Veſſels*, as well where it uſes to take in the *Blood*, as where it lets it out: So that the *Doors*, as it were, of the *Heart* being ſhut up, the *Circulation* of the *Blood* is for a time intermitted, as plainly appears from a ſwelling of all the *Veins* in the *Neck*, *Face* and *Forehead*. That this is the real Cauſe, may certainly be hence collected, namely, becauſe in long fits of *Laughter*, eſpecially in young *Children*, they look black in the *Face*, from the over abundance of *Blood*, becauſe of the ſtoppage of its courſe, and even Death it ſelf ſometimes puts an end to theſe over-gameſom Frolicks.

II. *How an Ague-fit, or large draught of Wine accelerates the motion of the Blood.*

Some things accelerate the Motion of the *Blood*, as a Fit of a *Fever* or *Ague*, and an over-large draught of ſtrong *Wine*.

The Reaſon hereof in *Fevers* is, not becauſe the *Blood*, with an exceſſive ebullition, flies up into the *Aorta*, but becauſe its æſtuation and ſenſe of *heat*, hurtful to the *Ventricles* of the *Heart*, being tranſmitted to the *Cerebellum* or hinder part of the *Head*, provokes the *Spirits* to accelerate its motion ſooner or later, as occaſion requires. Partly alſo becauſe ſome parts of the *Blood* thus rouſed and carried into the *Brain*, exagitate the *Spirits* there abiding, and raiſe them as it were into a mutiny; ſo that thoſe parts that fly up into the *Brain* from high drinking of *Wine* or other ſtrong *Liquors*, ſtir up the Inhabitants of the ſaid *Brain* into the like tumults.

III. *How it is that the Heart of ſome Fiſhes, ſevered from the Body, moves, and ſometimes tho' cut in pieces.*

A *Heart* taken from the *Body* in ſome *Animals*, leaps and diſcovers a ſenſible motion; nay, and ſometimes, tho' diſſected and cut into ſmall pieces, it does not preſently ceaſe from motion, but beats for ſome time after, eſpecially in *Fiſhes*, whoſe *Hearts* move longer than thoſe of any *Terreſtrial Animal*. But how can it be that a *Mans Heart* can borrow its *pulſation* from the *Soul*; when-as the *Soul* is indiviſible, and hath not parts of its own, ſeparate from the *Body*. We may better attribute this *Motion*, as well in *Man*, as in other *Creatures*, to the *Blood* contained within the *Fibres*, which *Motion* in the *Heart* is oft-times diſcerned by the *Eye*, or may be ſuppoſed to lurk, or lie hid within the *Fibres* of the *Heart*. For a very ſmall *portion* of *Blood* flowing from one part of the *Heart* to the other, being a little hotter, ſuffices for the effecting of this Pulſation. For by how much the leſs the quantity of any *Liquor* is, ſo much the more eaſily it rareties, and is dilated. And as ſome *Members* of our *Body* ſo much the more eaſily

repeat

repeat any *motion*, by how much the more frequently they have exerciſed it before: So the *Heart*, in regard it hath been accuſtomed to the *Diaſtole* and *Syſtole*, from the firſt moment of its *formation*, may be impelled by the ſmalleſt force imaginable to continue it. Whereupon ſince ſome remnants of the *Blood* are diſperſed in the *Hearts* taken out of the *Body*, it comes to paſs, that upon their being dilated by *heat*, the *Hearts* for ſome time beat, and by turns riſe and ſink.

IV. *This appears in the Hearts of Eels and other Animals.*

This is more particularly diſcern'd in the *Hearts* of *Eels* diſſevered from their *Bodies*, in which *Hearts* ſome *pulſation* ſtill remains for a time, that is, becauſe the *Spirit* of thoſe *Eels*, implanted in their *Hearts*, is by a ſmall heat eaſily raiſed into *Act*, and thereby *acts* upon the *Blood*, inhering in the ſubſtance, and by dilating it in ſome meaſure, contracts the *Fibres*, after which that dilated matter being a little diſperſed, the ſaid *Fibres* are again looſened. And this appears not only in intire *Hearts*, but alſo in the *Hearts* of ſome *Animals* diſſected into pieces, and that in every ſeveral *particle*, as in each whereof ſuch a dilatation happens about the diſſected *Fibres*.

V. *The Pulſe of an Artery is ſtopt upon the inſertion of a Pipe or Quill into it.*

Upon the thruſting of any *ſolid Body* into an *Artery* to ſtop the courſe of the *Blood*, immediately the motion of the *Artery* ceaſes; nay, if a *Silver Pipe* or *Quill* be put into the inciſion of an *Artery*, and the *Artery* be bound about with a *Fillet* thereupon, the ſame effect will immediately follow, altho' the *Blood* paſs through it.

The Reaſon of the firſt Experiment is plain, becauſe the *pulſe* of the *Arteries* is made by the *Blood*, rarefied by turns, and flowing into the *Arteries*, that is to ſay, whilſt the *blood* of the great *Artery*, poſſeſſing the place of that next the *Heart*, thruſts forward and agitates all the reſt of the *blood* contained in that *Artery*, and its *Branches*. But a thick *Body* being thruſt into the *Artery*, the courſe of the *blood* is ſtopp'd; and that portion of *blood* entring the *Aorta*, is not able to thruſt forward the other parts contained therein. As to the 2*d* Experiment, there muſt be a diſtinction to explain it aright. For either the *Pipe*, thruſt into the *Artery*, is of ſuch a thickneſs as to fill the whole capacity of the *Artery*, and thereby to be ſo join'd to its internal ſuperficies, as that it may not be able to overtop the *blood*, and to have ſo narrow a cavity within, as that it cannot without great difficulty be penetrated by the *blood*. In this caſe it is evident, that the *Pipe*, tho' free from any ſort of bending, will ſtop the Motion of the *Artery*. Or elſe the *Pipe* thruſt into the *Artery*, is of that Cavity as to afford a free paſſage to the *blood*; and then whether it be bound with a *Fillet* or not, it will no way hinder the *pulſation* of the *Artery*.

VI. *Why the Blood runs quicker in the uppermoſt parts of the Body, ſlower in lowermoſt.*

The *Blood* hath a quicker courſe in the upper parts of the *Body*, than in the lower.

The Reaſon is, becauſe in the upper part it flows eaſily into the *Heart* without help, (for the moſt part) of any thing elſe; but not in the lower part, except by the impulſe of the *Arterious Blood*, and ſometimes by reaſon of the contraction of the *Muſcles* it exerciſeth, it is not without difficulty driven upward. And therefore of neceſſity the *Circulation* thereof muſt be quicker in the upper parts.

VII. *Why the Veins have no Pulſe.*

The *Veins* have no *Pulſe*, notwithſtanding they are no leſs full of *blood* than the *Arteries*, and as well convey into the *Heart*, the *blood* returning from the whole *Body*.

The Reaſon is, becauſe the extremities of the *Veins*, by which the *blood* enters, are narrower than their *Channels* into which it flows, whereby it comes to paſs, that by paſſing from a narrower place into a broader, it loſes a great part of its force and vigor: Whence tho' it may fill the *Veins* with a continual afflux, and make them ſwell, yet it cannot agitate them with continual ſubſults, ſo as to be ſufficient for the effecting of a ſenſible pulſation.

VIII. *The Veins being bound, the Arm ſwells, and with continual Ligature drys up.*

If a *Mans Arm* be ſo bound, that all the *Veins* which tend thither, (by reaſon of the preſſure of binding) are ſo obſtructed that the *blood* is denied all farther acceſs to them; that *Arm* in a ſhort ſpace will ſwell and be puffed up to a high degree; but afterwards if the ligature be not looſned it will dry up and wither.

The *Veins* being bound, the *Arm* ſwells and is puffed up beyond its uſual pitch, becauſe the *blood* flows from the *Arteries* into thoſe *Veins*, and not finding a paſſage, cannot but inflate them, and increaſe their bulk; but by little and little this tumor is diminiſhed, and the *Veins* grow flaccid, becauſe the *blood*, ſtagnating in the *Veins* ſo bound up, becomes in a ſhort time more groſs; and by reaſon the Ligature preſſes the *Veins* too long, not only the Branches of the *Veins* are obſtructed, but alſo the paſſages of the *Arteries* are alſo ſhut up, and hindred from any farther tranſmitting the *blood* into tho *Veins*. Whence the ſerous part of the *blood* therein contained, evaporating by inſenſible *tranſpiration*, the *Arm* muſt needs fall from its ſwelling, dry up and wither.

IX. *During the pulſation of the Heart, all the Arteries do not always beat.*

We find by experience, that during the *pulſation* of the *Heart*, ſometimes all the *Arteries* beat, even to the utmoſt extremities of them, and ſometimes that they do not all beat.

When the *pulſations* of the *Heart* are very great and perceptible, then the *Arteries* are perceived to beat ſenſibly; but when the *Pulſes* are ſmall and languid, then there is perceived no ſenſible motion in the extremities of them. Whence HARVEY upon very good ground and conſideration, obſerves as followeth; *The impulſe of the Heart*, ſaith he, *is diminiſhed as it were in all its parts, at every diviſion of an Artery; ſo that at the laſt diviſion, the Arteries in a manner becoming Capillary, are like to the Veins, not only to their ſtructure and tunicles, but alſo in their reſt, and ceſſation from beating, ſince they have no ſenſible Pulſe, or at leaſt not always, except when the Heart beats very vehemently, and the Artery that attends is over-much dilated.* And this is the Reaſon why we ſometimes feel a *Pulſe* at the *Fingers* ends, and ſometimes not; and from hence Dr. HARVEY commonly made his indication of a *Fever* in *Children*, when he ſenſibly perceived a *pulſation* at their *Fingers Ends*.

X. *Whence Women have their Monthly Fluores.*

Women, when they arrive to a certain Age, have a flux of blood every Month.

The Cauſe of this *Profluvium*, ſome attribute to a *Nitrous Salt* which excites a fermentation in the *blood*: Whence the *Orifices* of thoſe *Tubuli* which reach to the *Womb*, being dilated by an efferveſcence, or as it were boyling of the *blood*, draw the ſaid *blood*, and as freely refund it back again. But when the *blood flows* without any ſtop, the *Ferment* reinforcing, dries it up, much after the ſame manner, as *water* guſhing forth, caſts out

the *Nitre* which it washes out of the *Earth*. Then the *Womb* being reduc'd to its former state, the same *Ferment* is raised in the same manner as formerly, and if not hindred, being collected together in the same space of time, and in a like quantity, and advanced to a like exaltation, produces a new *Fermentation* in the *Womb*.

XI. *Why sometimes dying Persons live for a time without any circulation of the Blood.*

Persons at the point of *Death*, oft-times live a considerable while without any *circulation* of the *blood*. This is most intelligible to *Anatomists*; who in their dissection of *Bodies*, often find the *Vena Cava* empty, and wholly destitute of all *Sanguineous Liquor*.

This may well enough be, by reason of the contraction of those *vessels* which serve for the transmitting of the *blood*. For tho' the *blood* of a *dying Person* is first refrigerated in the lesser *Veins*, and farthest distant from the *Heart*, and then thickned for want of heat; and thereupon the wonted *motion* of the *blood* passing out of the *Arteries* into the *Veins* is stopt; yet the *Vena Cava* may nevertheless be able to contain something of the *hot* and *fluid blood*; which by contracting it self, serves for a *fomentation* to the *Heart*, in the same manner as a *Hogs-bladder*, blown up and distended by the *Air*, the Mouth being taken off from the *Ureter*, expels by a spontaneous contraction, and drives forth part of the said *Air*. Forasmuch as the *Life* of the *Dying Person* is no other way ended, but upon the ceasing of the *circulation* of the *blood*: Since all the *vital sustenance* contained in the *Vena Cava* is consumed, and the *Vena Cava* dispossessed of the *blood*.

XII. *Why in strangled Persons the Arteries are found to be void of Blood.*

Hence it comes to pass, that in *strangled Persons* or *Animals*, the *Arteries* are wholly destitute of *blood*, when as at the same time the *Veins* are filled. For when the motion of the *Lungs* begins to fail, and the motion of the *Heart* still continues vigorous, the *blood* is forcibly ejected out of the left *Ventricle* of the *Heart* into the *Arteries*, and yet at the same time no new *blood* flows out of the *Lungs* into the said *Ventricle* of the *Heart*. Hence in a short time the *Arteries* become empty, a great argument nevertheless that at every pulsation or beat, the *blood* flows plentifully from the *Heart* into the *Arteries*: Whence upon the binding of the *Aorta* near the *Heart*, the *Carotides* or *Arteries* in the *Throat* seem empty, not the *Veins*; whence it appears, that the *blood* flows not out of the *Veins* into the *Arteries*, but rather out of the *Arteries* into the *Veins*.

XIII. *Why Surgeons tie the Arm in Blood letting.*

Surgeons when they let *blood*, bind the Arm indifferent streight, above the place where they design their incision, to the end the *Veins* may swell the more, and the *blood* issue out more freely.

The Reason is plain to those that admit the *circulation* of the *blood* in *Human Bodies*; forasmuch as a gentle binding cannot hinder the *blood* which is in the Arm from returning to the *Heart* through the *Veins*, nor new *blood* from being always impelled by the motion of the *Heart* out of the *Arteries* into the *Veins*. For the *Arteries* are placed beneath the *Veins*, and their skin is harder than to be compressed or bent by any slight ligature or pressure; besides that, the *blood* proceeding from the *Heart*, strives with greater force to advance through the *Arteries* towards the *Hand*, than to return from thence to the *Heart* through the *Veins*.

XIV. *An Experiment proving the motion of the Blood.*

This may be proved by another *Experiment*: For if upon the swelling of the *Veins*, for example of the *Hand*, the *blood* be pressed by the *Finger* towards the *Branches*, the *Vein* towards the *Branches* swells, the *Trunk* in the mean time falling, which immediately upon the drawing back of the *Finger*, rises and becomes inflate; that is, because the *motion* of the *blood* inclines from the *Branches* towards the *Trunk*, which while it is hindred by the apposition of the *Finger*, the *Trunk* must of necessity grow flaccid, and the *Branches* swell: Whence, when-ever it happens, as in a *Plurisie*, that the *passages*, for the conveyance of the *blood* through the whole *Body*, are streigthned, the Person is in danger, unless immediate *Phlebotomy* be applied, by which the *pores* of the Intercostal *Capillaries* are at length opened, and the *blood* regains its accustomed passage.

XV. *How Animals live some time after their Heart is pluckt out.*

Some *Animals* having their *Heart* cut out, still move, as *Lizards*, *Eels*, and the like. I have seen a *Frog*, which having its *Heart* taken out, remained some time alive.

The Reason possibly may be, because *motion* in *Animals* is effected by means of the subtiler parts of their *blood* which pass from the *Heart* to the *Brain* through the *Magna Arteria* or great *Artery*. But when there is a great abundance of those *subtile particles* in the *ventricles* of the *Brain*, it happens that the *Frog* remains alive for some time. Since no doubt but new *Spirits* have flowed from the *blood* contained in the *Arteries*: But if the *Head* be cut off all motion thereof immediately ceases, because then no more *Spirits* can pass from the *Arteries* into the *Muscles*. So that if any parts of these *Animals* still move after the *Head* is cut off, it proceeds from the *Spirits* only, which yet a while adhere to the *Muscles*, as is to be seen in the Tails of *Lizards* cut off; and in *Pidgeons*, who having their *Heads* pluck'd off, still move their *Wings* and *Feet* for a good while, in regard the *Animal Spirits* are still fluttering in those inferiour *parts*, and by those aforesaid intermediate Canals, tend from one *Muscle* to another, until at length they are dissipated, and after that their *motion* wholly ceases.

CHAP. VII.

Of the Actions of Animals.

I. *How the Badger deceives the Hart.*

THE *Badger Ajachtlus* or *Tatus* in *Brasil*, lies with his *Face* upward in rainy weather, and takes in the water by a large passage into the *Belly* between the *Ribs*, that looks like a little Pool, and so continues after the shower is over, sometimes for a whole day together, or till such time as the *thirsting Hart* coming near by chance, sets his *Mouth* to the *Imagined Pool* to drink, which the said *Badger* perceiving, catches hold of the poor *Beasts Mouth* and *Nose*, and never lets it go, till tired with strugling it loses its *Life* together with its wasted *Spirits*.

II. *How the Fox deceives the Geese and Hens.*

The *Fox* is a very crafty Creature, who sometimes counterfeits himself dead, and lies without all sense of *motion*, till the inveigled *Geese* and *Hens* approach so near that they are easily snapt and devoured by him.

Many hereupon attribute Reason, however imperfect, and as they call it *Umbratile*, to *Brute Beasts*,

Beasts, by which they manage their *actions* and effect their *designs*, with a semblance of *Cogitation*. And to this Opinion they are induc'd by their being indued with *Tongue*, *Ears*, *Eyes*, and other *Organs* of *Sense*: From whence they conclude, that they have a perception like to that of ours. For since in our way of *Sensation*, *Perception*, or *Cogitation* is included, they will have it that the like sort of *Cogitation* is also to be attributed to them. But these men seem not sufficiently instructed in the nature of *Cogitation*, when they assign it to *Brute Animals*: Forasmuch as those effects of sensibility mentioned, are proper as well to the *Body* as to the *Mind*. Otherwise all other *Animals* might be asserted to be equally indowed with *Intellect* and *Will*, and must of necessity be judged, not only *equal*, but even *superiour* to *Mankind*; since we find that they comprehend objects at one view, and attain to what they design the very first time they attempt it; a thing scarcely to be allowed, even to the wisest of *Men*, who make their conclusions and results, not without long *Discourse*, *Study* and *Cogitation*, which these *Creatures* at once, and by a simple apprehension attain to.

III. *There are affections in Brutes, but not reason.*

I acknowledge indeed certain *affections* in them, by which they are impelled to the performance of their *actions*, but not *Cogitation*, and the *modes* of *thinking* proceeding from it. So the *Badger* lying on his Back in the open *Air*, to retain the *Water* which the *Rain* had poured into his *Belly*, as it were into a *Trough*, and being wakened by the approach of the *Hart* to *drink*, is led by instinct to catch hold of his *Mouth*, by the closing and shutting together of its strong Coat of *Mail*, to get possession of his *Prey*; and afterwards calling to mind the said accident, he might from time to time, as often as *hunger* urg'd, make use of the same stratagem for the getting of new *provision*. All which things might very well be effected, without the help of *Reason*, *Design* or *premeditation*, but only by the disposition of the parts of the *Body*, and the frame or structure of the *Organs*.

IV. *How Brutes come to have a memory.*

Brutes indeed have a *memory*, not by virtue of a *Rational Soul* or *Mind*, of which they are destitute, but of motions formerly received by tracts heretofore impressed by the sense upon the *Brain*, which *motions* are presented again singly to the common *Sensorium*.

V. *Whether the Dogs make any rational choice in following their Game.*

Dogs oftentimes having lost the *Scent*, are at a stand, and if it happen that there are several *ways* or *paths*, for example three, having by the *smell* try'd two, they fall into the third without any demur, not in the least doubting, but certainly assured that the *Deer* or *Fox* hath taken that course.

This *Action*, which seems to carry some semblance of Reason in it, is only the work of a *Corporeal Organ*. For the *Dogs*, while they pursue the *Deer* with extraordinary earnestness, it may possibly happen, that they may make but a slight search in the first Path, and then leaving that way betake themselves to the search of the others, but finding therein no tract of the *Beast*, may lastly return again to the first, wherein the *Scent* being recovered, and all demur set aside, they follow the track, and at length catch the *Beast*.

VI. *How Dogs know their Masters*

Dogs in a mixt Company of men, keep close to and follow their own *Masters*, as knowing and distinguishing them from other *Men*.

Of this there can be no other reason given, than because from divers persons different exhalations arise, which the *Dogs* discerning, are affected with none so much as those which exhale from their *Master*, as being longer accustomed to them. For these *particles* exhaling from the *Body* of the *Master*, so affect the *Fibrils* of the *Nerves* that are extended into the *Dogs Nose*; that thereupon there follows such a concourse of the *Animal Spirits* into the *Muscles* of the *Dog*, as disposes him to fawn upon his *Master*. *from other Men.*

VII. *How Camels are taught to Dance.*

Camels, that delight very much in *Musick*, are oft-times taught to *dance*: Some have been seen to keep exact Time and Order in their *movements* at the sound of a *Drum*, sometimes in a round, sometimes meeting, sometimes falling off.

Their manner of Institution in this faculty was thus. When they were yet young and tender pointed, they were shut up in a Hot House, whose Pavement was on purpose heated; then just before the Door there was a *Tabour* or *Drum beat*, mean while the *Beasts* not well-enduring the heat of the *Floor*, lifted up sometimes one *Leg*, sometimes another, and by such a continual *motion*, were forced to bestir themselves. This *exercise* being thus continued for divers *Months*, they were so accustomed to it, that when-ever they came in publick, and were brought forth into the open *Air*, at the sound of a *Drum*, on purpose beat, they lifted up their *Legs* according as they had been accustomed, but with a *motion* somewhat more regular than what they had been used to, as being now more unforced, and so framed a compleat *Dance* in exact *time* and *measure*.

VIII. *Whence proceeds the diversity of tones in Hens.*

A *Hen*, when she *calls* her *Chickens*, *Clucks*, when she warns them to flight by reason of the *Kite*, she holds it out longer and advances it louder, when taken she vehemently, and, as it were, repeats a sobbing *tone*: When she laies an *Egg*, she *Exults* or *Cackles*; when she hatches her *Eggs* to produce the *Chickens*, she utters a rougher, thicker and slender *tone*, than when she calls them to her; when she *broods* over her *Chickens*, she uses a lower and more *depressed voice*, and different from all the rest.

This diversity of *sounds* which is observed in *Hens* and other *Animals*, proceeds from their various *affections* or *passions* which move them and alter the disposition of their *Body*. For whereas the *Voice* is produced by the emission of the *Breath* out of the *Mouth*, through the *Aspera Arteria*. It is apparent that according to the various disposition of the *Instruments* which conduce to the forming of the *Voice*; peculiar *Voices* or *Sounds* must needs arise. And since according to the different *passions* wherewith they are moved, the *Organs* obtain a different disposition: Hence it comes to pass that *Animals* utter different *Voices*, and signifie by various *Tones* their trouble or delight; which *Sounds* being conveyed to *Animals*, either of the same or different kinds, variously affect them. So the *Howling* of a *Baboon*, tolles the rest of that kind, tho' remote from him, and calls them to his Aid. So a *Hog*, when he is set upon by *Dogs*, by his loud *grunting* and *crying* out, calls the neighbouring *Hogs* to come and help him. So a *Hen* by its different *pipations*, signifies its various passions, according to the various disposition of the *Vocal Organs*, which the predominant *passion* produces

duces in its *Heart*. So that whoever will penetrate into the Nature of *Brute Animals*, and dive into their moſt hidden *affections*, may eaſily and without labour diſcover the reaſon of their ſeveral *Cries* and *Vociferations*, and unfold by what motion of the *Heart* they are impelled; as I have more at large made out in my *Diſſertation* of the want of Senſe and Knowledge in *Brutes*.

IX. *The reaſon of the Craft uſed by Hares to avoid the Dogs.*

Hares, the better to elude the *quick Scent* of the purſuing *Dogs*, confound their *Tracks*, by ſhifting and traverſing from one courſe to another, and moſt eſpecially they avoid *ſhrubby* and *brambly Places*, leſt by rubbing off their *Hairs* againſt them, they ſhould afford the ſtronger *Scent* to the *Hounds* as they paſs by. Sometimes they betake themſelves to *Hedges*, where they lie and skulk; ſometimes they run into the midſt of a *flock* of *Sheep*, that ſo the *ſcent* of their *Bodies* may be drown'd and loſt by the overpowring *ſcent* of ſo many other *Bodies*: Nay if they are overmuch preſſed by the *Dogs*, they come back the ſame way again, or by a huge leap bounce into their Cave or Lodging.

All theſe *tricks* which are aſcribed by ſome to the Craft and Policy of the *Hare*, are only the effects of their *Fear*. For what can be more obvious to *Hares*, when the *Hounds* purſue, than to have recourſe to places of retreat, and by their ſhelter to preſerve themſelves from their Enemy? When there are no *Woods* to fly to, haply *Herds* of *Deer* or *Flocks* of *Sheep* preſent themſelves to *Eye*; thither then immediately they run, and intermingle themſelves for refuge, till by the cry of the Hounds they find themſelves freed for the preſent, and ſo continue their flight homewards; or if they take their flight, as ſoon as the *Dogs* are in purſuit, it is to be imputed to their fear. By which the *Spirits* of the *Brain* being agitated, will not ſuffer them to ſit down in quiet, and neglect the imminent danger. As we ſee in perſons tired and wearied, who not having an immediate opportunity of *reſting*, are forced ſtill to keep moving a little, by reaſon of the commotion of the *Spirits*, which haply is the cauſe that *Hares* by reiterated Vaultings, leap to and fro, and ſpringing high in the *Air*, recover their abodes: Nor can there be any other reaſon given why tired *Hares* make ſo many *windings* and *turnings*, oft-times repeating the ſame *Tracks* over again; but becauſe hurried with overmuch *fear*, they become affected with great diſtraction; and are thereby diverted from their firſt intended *courſe*, unleſs the *Hounds* in their cloſe purſuit are ſo inevitably hard upon them, as to force them back into their firſt *Path*.

X. *How Birds with ſuch Art and Order build their Neaſts and bring up their Young Ones.*

Birds are indued with wonderful ingenuity in the bringing up of their Young; for preſently after *Copulation*, their main buſineſs is to build their *Neaſts*; they pick up Moſs, Chaff, Straws, Feathers, *&c.* with which they build their Neaſts round; and having laid their *Eggs*, they ſit upon them, hatch their *Young*, and in a ſhort time teach them to fly.

All theſe things may be effected without the help of *Reaſon*, for it is certainly natural and innate to *Birds* to couple at certain ſet times, and to this they are impelled, either by the *Seaſon* of the *year*, or by the *Meats* upon which they feed: Likewiſe certain it is, that *Eggs* are produced from *Copulation*, which being ſhut up in the *Belly* of the *Female*, cannot but be burthenſome to the bearer of them; as ſoon as they are arrived to any magnitude, whereby it comes to paſs, that deſiring to unburthen themſelves of them, they chooſe a place fitting wherein to lay them, and underlay it with the ſofteſt things they can procure, and which are eſpecially grateful at that time by reaſon of the weight of the *Eggs*; and all this by no other conduct of *Reaſon* than *Cats* and *Dogs* make uſe of, when upon the approaching time of their *Whelping* or *Kittening*, they ſeek out a place commodious for the bringing forth of their *Litter*. The *Eggs* being laid, they ſit upon them, by reaſon of a certain contexture of the *Fibres* at that time whereby they are diſpoſed hereunto, as we ſee in *Hens*, which at a certain time of the year; ſit cowring on the *ground*, as if they were ſitting over their *Eggs*, when as indeed there are none under them; which plainly ſhews, that at that *ſeaſon* they are affected with a certain indiſpoſition which *brooding* eaſes and removes. Whence it appears that all theſe things are not effected by *Ratiocination* or *Cognition*, but by the motion only of the *Spirits*, and the diſpoſition of the other parts of the *Body*. In like manner as artificial *Fountains*, *Clocks* and ſuch like *Automata*, wrought by *Human Ingenuity*, which perform many things that cauſe wonder, and all by the orderly ſtructure of their parts only.

XI. *How the Caſtor builds its Cottage.*

The *Caſtor* or *Beaver*, an *Amphibious Animal* in *Virginia*, thus fortifies it ſelf againſt the force of the approaching *Winter*; they chooſe a place upon a declining *ground* near a *Rivers* ſide, againſt which with great *Induſtry* and *Labour*, raiſing a kind of *Bulwark* with *Turf*, *Boughs* of *Trees* and the like, they ſtop the courſe of the *water*, and make a little *Lake* or *Pool*; and about the Head thereof they chooſe a little riſing *Hillock* whereon to build a Cottage or little Houſe; on the topmoſt part whereof they leave an open *Portal* for the *Air*, here they lay up *Boughs* cut from *Trees*, on which they feed; moreover digging Mines under the *water* to paſs to and fro, when and where they pleaſe, they bid defiance to all the Hunters Arts.

XII. *That there is no more of Cogitation in Brutes than in a Vine, or in the Stomach.*

And all this may be performed both by *Beavers* and other *Creatures* without the help of *Councel* or *Rational Cognition*, but by a certain blind impulſe of *Nature*; for if *Cognition* be allowed of in theſe *Creatures*, it may as well be allowed of in a *Vine*, which as if it foreſaw its inability to ſuſtain its future burthen, hath recourſe to the *Elm*, which it catches hold on for a Prop to bear the load of thoſe heavy *Cluſters* it muſt hereafter bring forth, and winds about it with its wreathed tendrels, as with ſo many graſping Hands: Or as in the *Stomach* either of *Man* or *Beaſt*, wherein the *Aliment* is ſo digeſted, as if by foreſight and deſign there were made a diſtinction between the profitable and unprofitable *Juice*, and a diſtribution ordered accordingly, part being ſent out to the inteſtines, part to the Heart, thence to be conveyed to the Limbs and Head, according to the ſeveral occaſions and neceſſities of each part. And certainly ſince the fore-mentioned *Animals*, build their Habitations, and manage all other affairs by the ſame impulſe; it is a great argument that this proceeds from *Nature*, that is,

from

from the diſpoſition of the *Organs*, rather than from any rational *Cognition*.

XIII. *How the Remora puts a ſtop to Ships in the Sea.*

The *Remora* retards a *Ship* under *Sail*, and ſtops its Courſe. An inſtance whereof we have of a Ship of *Francis*, *Cardinal of Turon*, ſailing from *France*, and ſtop'd in its mid courſe, from the Relation of *Petro Melata of Bononia*.

This ſo great force of the *Remora* baffles the ſubtile apprehenſion of all the *Philoſophers* I ever yet read of, who frankly acknowledging the ſlenderneſs of their underſtanding, profeſs themſelves wholly ignorant of the cauſe of this ſo ſtupendious a matter, and have nothing but that *Aſylum* of *Aſſes* to have recourſe to, their *Occult Quality* forſooth: Nor is it without Reaſon that they are at this loſs; for indeed it muſt be a very difficult thing to be reſolved of the Reaſon of a thing that never was. For if the Writings of Authors that make mention of the *Remora* be ſeriouſly conſidered; it will plainly appear that what they delivered concerning it, depends not upon their own Teſtimony or Opinion, but is taken upon truſt from others. Whence ARISTOTLE in his 2*d* Book of *Natural Hiſtory*, having delivered all he had to ſay concerning the Nature and Qualities of this *Creature*, adds at laſt, *as ſome relate*, PLINY writes in his 9*th* Book; *This Creature ſticking to the Keel, the Ship is ſuppoſed to move the ſlower*: And *Plutarch* in his *Sympoſia*, *Some*, ſaith he, *there were who laught at this tradition of the* Remora, *as an Idle and Fabulous Story*. And many others there are, too long here to recount, who believe the Story of this *Fiſh* to be but the ſubject of an Idle Fiction impoſed upon the credulity of Mankind.

But that *Ships* have been hindred on a ſuddain from Sailing is not denied. Muſt therefore a little *Footleſs Fiſh*, which according to *Ariſtotle*, is but a kind of *Murex* or *Purple Fiſh*, and like to a *Snail*, effect ſo great a wonder? Why may we not as well impute it to a ſuddain *Ebb* of the *Sea*; ſuch as in the Bay of *Sicily* divers have had experience of, by which *Ships* in their full career of Sail have on a ſuddain been retarded and rendred wholly deſtitute of Motion? Who knows not that very vehement guſts of Wind ſometimes break forth in a moment from the bottom of the *Sea*, and with a vaſt force drive againſt the Stream? Do not ſuch accidents as theſe ſuffice to retard *Ships* under Sail, without the help of a poor deſpicable little *Fiſh*? Doubtleſs they do, and I cannot but poſitively look upon them as the real cauſe of the *Ships* immobility. Beſides if the *Remora* be able of it ſelf to act ſuch a wonderful thing, why may it not as well do the ſame being received into the *Ship*? Since it is reported of it, that it hath been by the Mariners taken ſticking to the *Rudder*, and brought into the *Ship*. Which was the very obſervation of the Emperour *Cajus*, who ſailing from *Aſtura* to *Antium*, when a *Remora* that was ſaid to have ſtuck to his Gally, was taken and brought into it, wondred why it could not then as well do the ſame thing, and transfuſe its virtue as well within as without.

XIV. *How Brute Animals come to preſage approaching Weather.*

Brute Animals foretel *Winds*, *Fair Weather*, *Rain*, &c. *Hedghogs* drawing in their *Quills*, are a great ſign of *Stormy Weather*; *Halcyons* betaking themſelves to their *Neaſts*, betoken a *Fair Seaſon*: All tame *Foul*, as *Ducks*, *Geeſe*, *Game-Cocks*, &c. give certain preſages of change of *Weather*.

This faculty they have from a perfect diſpoſition of their *Organs*. For ſince there are in the *Air* certain prognoſticks of future *Weather*, *Brute Animals* by reaſon of that vigour of ſome *Senſes* more than others, with which they are indued, more eaſily preſage thoſe *Seaſons* than *Men*, whoſe *Imaginations* are taken up with variety of *Objects*, and whoſe common *Senſes* are not altogether ſo ſharp as thoſe of *Beaſts*. However they cannot properly be ſaid to foretell any more than *Warts* on a *Mans Toes*, or *Limbs* out of joint can be ſaid to be indued with præſcience, or the knowledge of future things.

XV. *How Mens Bodies preſage Storms and wet Weather.*

Whatſoever *Diſlocation*, *Fracture* or *Solution* of *Parts* happens to be in any *Member* of the *Body*, portends by a greater pain at that time than any other, a *Stormy* or *Wet Seaſon*; but eſpecially that *Venereal Diſtemper*, that with a far more exceeding pain attends perſons of a lewd and incontinent courſe of Life: Foraſmuch as theſe Men, when the *Northern Winds* begin to blow, are ſooner aſſaulted with thoſe *pains*, in regard at that time their *Nerves* are intended and their *Muſcles* grow ſtiff, and are cruelly tormented with thoſe vitiated *humours* that are rivetted in the *Members*; for in theſe parts chiefly lurks the ſaid *Diſtemper*, which influenc'd by the *Seaſon*, exerciſes a kind of butchery in the inmoſt receſs of the *Body*. By the ſame ſenſibility of *Weather*, *Frogs Croaking* more than uſually; *Swine routing* in a bundle of *Hay*; *Cows* and *Oxen* holding up their Snouts to the *Sky*, and ſnuffing, preſage *Rain* from the humidity of the *Air*.

CHAP. VIII.

Of the Averſion and Affection of Animals.

I. *Whether the Baſilisk be Miſchievous in its looks.*

THE *Baſilisk* hath that kind of pernicious Venom, that it is ſaid to deſtroy a *Serpent*, tho never ſo great, by breathing upon it: Nay, if credit may be given to *Hiſtorians* about this matter, if it eſpy any Man approaching to its *Cave*, it kills him with its looks.

I cannot eaſily perſwade my ſelf that the *Baſilisk* can prove ſo miſchievous to *Mankind* with its *Eyes* only; for how ſhould it come by ſo fatal a malignity in its *Looks*? With what a vaſt force muſt Rays be darted from his *Eyes*, to pierce quite through the whole Body of Man, and deſtroy him even at a diſtance? But I am rather apt to believe, if what is reported of the *Baſilisks* fatal preſence be true, that the killing ſtroke he gives, proceeds not ſo much from *Spirits* darted from his *Eyes*, as from the peſtiferous blaſt of *Breath* blown out of his *Mouth*. Since it is certain, that he cauſes *Trees* and *Shrubs* to *wither* and *die*; breaks *Stones*, blaſts *Herbs*, and that not by contact only, but parches and burns them up by his *Breath*. Hence all other kinds of *Serpents* dread and ſhun his *poiſon*, and fly him as a Common Enemy of all *Creatures*: And as ſuch a one *Lucan* deſcribes him in his 9*th* Book, where among other things of him he ſaith,

Lord Paramount he reigns of th' empty Sand,
And from him drives all Creatures near at hand.

II. *The ſame is done by Dragons.*

Well therefore may ſuch a deſtructive Breath as this, blown out of his pernicious *Mouth*, and lighting upon any *Man* as he chances to paſs by, penetrate through his whole Subſtance, by its ſubtil and virulent quality, and by inverting the contexture of the *Fibres*, ſo afflict him, as to render him leſs capable of performing the Offices of *Life*. The ſame is related of *Dragons* in the time of *Philip*, King of *Macedon*, for that the Soldiers paſſing through two Mountains, fell dead as they marched.

The Reaſon, as *Socrates* reported was, that by his proſpective Glaſs he diſcerned two *Dragons*, one upon each Mountain, breathing forth their *Venemous Breath* one againſt the other: By the power whereof whatſoever went between eſcaped not *Death*: For this ſtory we have the authority of *Libanius De Origine Rerum*.

III. *Of the Benuming Fiſh.*

There goes a Story of a *Fiſh* in the Iſland called *Cayenne*, not much unlike a larger ſort of *Eel*, which by touching the utmoſt end of the *Fingers*, or the very Staff or Stick held in the Hand, ſtrikes a numbneſs through the whole *Arm*, and the parts near about it, accompany'd with a kind of *Scotomy* or heavy dimneſs of *Sight*. It is alſo related of this *Fiſh*, that to make a prey of other *Fiſhes*, and prepare them for his *Tooth*, he ſtrikes them with the extremity of his *Tail*, and ſo benumbs them into an irreſiſtance. This Miſchief is to be imputed to the virulency of thoſe *Breathings*, *Evaporations* and *Effluviums* which proceed from theſe *Creatures*; much like thoſe that ſteam from *Aqua-Fortis*, *Quickſilver*, and ſuch like ſort of *Minerals*.

IV. *Why the Lion dreads the Voice of the Cock. The Elephant that of the Sow.*

So great is the *Antipathy* between the *Cock* and the *Lyon*, that the noiſe of his *Crowing*, or the very fluttering of his *Wings* ſtrikes a terror into the *Lion*. The *Elephant* ſtarts at the grunting of a *Sow*, and tho' the ſtrongeſt of all *Beaſts*, trembles when he hears that noiſe.

This *Averſion* in both theſe *Creatures* proceeds from ſuch a Contexture of the *Organs*, as that the noiſes of the *Cocks* Crowing, and the *Sows* grunting, being conveyed to them, pierce their *Bodies* with a ſort of Vellication, and as it were rend them a ſunder with a kind of ſharp ſmiting violence; inſomuch that being received into their *Ears*, they open the Pores of the *Brain*, not only into the *Muſcles*, that ſerve for the moving of the *Members*, but alſo into thoſe *Fibres* of the *Heart* that conduce to the exciting of *Fear*. Who knows not that the grating noiſe of a *Saw* is very harſh and ungrateful to the *Ear*? In fine, therefore it is that a *Lion* trembles at the *Crowing* of a *Cock*; and an *Elephant* is affrighted at the *Grunting* of a *Sow*, becauſe their *Organs* are ſo diſpoſed, that they cannot receive in thoſe *ſounds* without great trouble and offence.

V. *How it comes to paſs that Elephants cannot endure the ſight of any thing that appears Red.*

To the ſame cauſe we may refer that which is related in the *Hiſtory* of the *Macchabees*, namely that *Elephants* loaden with Wooden *Towers* full of Armed Men, at the ſight of ruddy colour'd *Grapes* or *Mulberries*, were ſo exaſperated thereby, that they could not forbear ruſhing into the midſt of the *Enemy*, without regard either to their own or their Charges danger; and all upon this occaſion, that *Elephants* have their *Eyes* ſo diſpoſed as to be ill affected with *Red*, or any Colour inclining thereunto; and by certain Rays flowing from ſuch a Body, to have thoſe paſſages of the *Brain* dilated, which open thoſe *Fibres* of the *Heart* that conduce to the exciting of Rage and Fury.

VI. *The reaſon of the Averſion between a Camel and Horſe, Cat and Mouſe.*

A *Camel* and a *Horſe* have great averſion to each other, ſo that theſe two *Creatures* can by no means be brought to live together without extraordinary diſſention and hoſtility. The *Weeſel* abhors the *Toad*, and comes not near it, but with great reluctance. The *Mouſe* flies the *Cat* as its mortal *Enemy*. The *Pheaſant* deſigns againſt the *Hart*, and to do him a miſchief ſits upon his Back, twitches up his Hair by the Roots and pecks his Fleſh with its Bill.

The *Peripateticks* expreſs all theſe Enmities and Averſions by no other name than that of *Antipathy*, thinking they have diſcharged themſelves very well, and given a ſufficient explication, when they tell us, that it is a certain natural hatred between one *Animal* and another, by which they fly and abhor each others ſight. But who is there ſo ignorant as not to underſtand that we are not one jot the wiſer by this Anſwer? That there is a diſſention and hatred in ſeveral *Creatures* one with another; but how this enmity ariſes, or in what motives it is founded, certainly it can be no otherwiſe than from ſome *paſſion* tranſmitted into the *Brain*, through the external *Senſes* by the help of the *Nerves*. For ſuch is the diſpoſition of the *Brain*, and ſuch the contexture of the *Fibres* in *Animals*, that from ſuch a ſpecies proceeding from without, ſuch an affection muſt needs ariſe, no otherwiſe than as Heat hardens ſome *Bodies*, and ſoftens and melts others. And hence it is that the ſmell of a *Camel* ſo diſturbs the Brain of a *Horſe*, that it renders him wholly unfit for ſervice in the *War*. The evaporations only of Effluviums from a *Horſe*, hath ſuch a power over an *Elephant*, as to drive it into a frantick rage, which effect can certainly be Imputed to nothing but ſuch or ſuch a diſpoſition of the *Organs*, or contexture of the *Fibres*. And much after the ſame manner it is that a *Blood-Colour* diſorders an *Elephant*: The ſmell of a *Panther* attracts *Apes*, and Fear ſeizes a *Lion* at the ſight of a *Cock*.

VII. *Whether a ſlain Body bleeds afreſh at the ſight of the Murtherer.*

Blood is ſaid to guſh out of a Wound, tho' bound up, upon the approach of the Perſon that gave it; and the *Lawyers* of ſome Countries take it for more than a half proof of *Murther*, when in the preſence of any ſuſpected, the *Body* of a ſlain Perſon begins to fall a *bleeding* a freſh.

Lemnius in his 2*d* Book *Of the Occult Miracles of Nature*, aſſigns no other Cauſe to this Effect but *Imagination* only. *So great*, ſaith he, *and powerful is the force of hidden Nature, and ſo ſtrong is Imagination, that ſo long as any ſpark of Life is left, and the ſlain Body not quite cold, the Blood may poſſibly guſh out a-freſh, and boil by means of the Cholers retained heat.* Others refer it to the *Antipathy* that is between the *Carcaſe* and the *Murtherer*, as if there were ſtill remaining ſome ſtrugling of the *Spirits*, ſomewhat like to that which ſtruck the horror at the time of the *Murther*. But theſe *Examples* carry little weight with me who look upon the thing as dubious; and if I may take the boldneſs to contradict ſo many *Aſſertors* of this accident, altogether falſe: Foraſmuch as I my ſelf have ſeen the Dead Body *bleed* at the *Noſe* and *Mouth* after three

three or four days, when the *Murtherer* hath not been preſent, nay, not living. Beſides, I preſume there has ſcarce been any one heard of that could confidently atteſt upon *Oath* the truth of the thing, but rather relied upon the credit of Relaters or authority of Writers.

But let it be granted ſometimes to happen, that in the preſence of the *Murtherer*, a *Murthered Body* may fall a *bleeding*; muſt therefore the Preſence of the *Murtherer* be immediately concluded from this accident of the *Bodies bleeding*, or at leaſt a ſuſpicion thereof be implied? Why may not the ſaid accident of *bleeding* be rather imputed to Natural Cauſes, a thing indeed ſcarcely to be avoided, if all things which commonly happen about theſe *Dead Bodies* be well examined. The *Body* is carried into a Room where there is generally a great confluence of *Spectators*. By the breath then of ſo many Men the *Air* muſt needs be heated, and the *Blood*, tho' cold, be excited by this warmth, and conſequently ſome ſmall quantity of it may break forth out of the *Noſe* or *Mouth*. From all which may be concluded how weak a teſtimony this *bleeding* is, and how ſlight thoſe determinations are which *Judges* have made about the preſence of the *Murtherer*, unleſs we aſſert with PLATO that the *Souls* of Perſons *murthered* perſecute thoſe by whom they have been deprived of *Life*.

Thy Ghoſt i'le ever haunt, where e're it is;
Thy Soul, Bad Man, ſhall dearly pay for this.
Virg. 4. Æneid.

VIII. *Beaſts have an averſion to the killers of their Kind.*

Beaſts have a notable averſion to the Killers of their *Kind*, and to the utmoſt of their ability proſecute them: I have wondred, when being ſome time in the *Country*, I have obſerved all the *Swine*, and even the very *Pigs* of a certain *Village* grunting out their Clamours againſt one *Paſſenger* particularly more than others, and as it were preparing to ſet upon him; and asking the reaſon hereof, was told that this perſon was a *Butcher*, imploy'd in the killing of all the *Hogs* and *Pigs* of the ſaid *Country Town*.

This *Averſion* of the *Swine* might very well be cauſed by the *ſmell* of the ſlain *Hogs*, or of ſome of the *blood* that ſtuck upon the *Butchers Cloaths*, which being corrupted and debaſed from its natural temperament, offended their *Senſe*, and begat a certain *horror* in them. For it is not to be doubted but that the degeneration of any thing from its natural temperament, makes an ungrateful impreſſion upon *Animals*, eſpecially if it be from thoſe of the ſame kind, and hurts and offends them much more than if it proceeded from thoſe of a different kind.

IX. *Why ſome Inſects have an averſion to Oil.*

If the *Bodies* of certain *Inſects*, eſpecially of the *Silkworm*, *Graſhopper*, *Bee*, *Locuſt* or *Waſp* were ſo beſmeared with *Hony* or *Oil*, that the black *ſpecks*, running along their *Bodies*, were all covered, they would preſently *die*, nor could they by any Art poſſibly be recalled to *Life*.

The Reaſon is, as *Malpighius* very well obſerves, becauſe *Inſects* have not only *Lungs* as other *Creatures*, but are ſo abounding with that ſort of *Bowel*, that every Section of them is furniſh'd with double *Lungs*: Nay, thoſe *blackiſh Holes* are as it were ſo many gaps, which lead to ſo many rough *Arteries* which convey the *Air* into the *Heart*, *Spinal Marrow* and other *Internal parts*; ſo that no wonder if upon the ſtopping up of their *Orifices*, the ſaid *Inſects* or little *Animals* periſh and die for want of *reſpiration*.

CHAP. IX.

Of Sleep and Waking.

I. *Why Infants are moſt chiefly addicted to ſleep.*

Infants and *Children* ſoon fall *aſleep*, and being in a ſound *Nap*, ſleep long and are not eaſily *wakened*.

Children are very much abounding with moiſture, with the thickneſs whereof the *Pores* of the *Choroidal Contexture*, and the *Arteries* called *Carotides* are ſomewhat ſtreightly cloſed and ſhut, and conſequently afford not a very free paſſage to the Animal *Spirits*. For as we ſee ſometimes the *Sails* of *Ships* ſlack and lank, when there blows but a gentle gale of *Wind*, not ſtrong enough to ſtretch and expand them; ſo when there is not ſo great a plenty of *Animal Spirits* proceeding from the *Heart* as to fill the *Marrow* of the *Brain*, and to keep all its paſſages open, *Sleep* muſt needs ariſe. Since then in *Children* and *Infants*, *Humours* very much abound, the Motion of the *Animal Spirits* is by the reſort of them to the *Brain*, much diminiſh'd, and the *Pores* of the *Brain* apt to be obſtructed.

II. *Who they are that ſooneſt fall aſleep.*

Hence it comes to paſs, that they who have a more than ordinary *Cold* and *Moiſt Brain*, as perſons of a decrepit Age generally have, ſoon fall *a ſleep*. On the contrary, thoſe that are of a more *dry* and *hot temperament*, paſs many times whole *Nights* without *ſleep*, and being vigorous and in the prime of their *Age*, are ſatisfied with a ſmaller portion of *ſleep* than *Children* or old *People*.

III. *Why we fall ſooner aſleep ſitting by a Fire, than in another place.*

We *Sleep* ſooner lying down than in any other poſture, and ſooner by a *Fire* than elſewhere.

That we ſooner *ſleep* lying than otherwiſe, is becauſe our *Heart* is then parallel with the *Horizon*; whence it comes to paſs, that the *Blood* proceeding from the *ſiniſter Ventricle* of the *Heart*, paſſes to and fro with an equal force, which, when we ſtand or ſit, it cannot do, for then the more ſubtile part of the *Blood* only aſcends; ſo that in regard the groſſer part is conveyed to the *Head* through the two *Carotides*, and the two *Vertebral Arteries*, conſequently the fewer *Spirits* are from thence generated; the want whereof cauſes an inclination to *Sleep*. But that we ſooner than ordinary *ſleep* by the *Fire*, is becauſe the *Pores* of our *Body* are much enlarged by the *fiery particles*, ſo that our *Body* becomes like a courſe *Sieve* or *Cullender*, by reaſon whereof the *Animal Spirits* take their flight the faſter; thus the *Body* tired and debilitated, drops at laſt into a ſweet *ſleep*.

IV. *How Tobacco taking, both procures and drives away ſleep.*

It is vulgarly affirmed that the *ſmoaking* of *Tobacco* both induces *ſleep* and drives it away; and that it both excites and expels *Hunger* and *Thirſt*.

The Reaſon is, becauſe the *Animal Spirits* being ſtroak'd, and as it were led into a Dance by this ſort of *Fume*, grow abſolutely deaf to all troubleſom *accidents*; nay, whatſoever of difficulty lies upon them to be done or ſuffered by them, they

they go through with eaſe and undiſturbed: Wherefore to *Soldiers* and *Mariners* the uſe of *Tobacco* is a thing not only of advantage, but almoſt of neceſſity, foraſmuch as it renders them undaunted and fearleſs, and ready to undergo all dangers, patient of *Hunger*, *Cold* and *Labour*; as gently raiſing and exalting, and as it were tickling the *Animal Spirits* to quick and expanſive *motions*, and is a recreation to them, no leſs than the carouſing of full *Glaſſes* of *Wine* to others.

V. *Poppy, Saffron, &c. cauſe ſleep.*

Poppy, *Saffron*, *Mandrakes*, and the like ſtupefie, benumb and lay *aſleep* thoſe that take them.

The Reaſon ſeems to be, becauſe *Plants* of this Nature are full of a very Uliginous or Clammy ſort of *Juice*, with which the *Pores* of the *Choroidal Contexture*, being ſtopped, are diſabled from conveying to the *Brain* the *Spirits* proceeding from the *Heart*. For as ſome *Plants* are obſtructive to the *Spleen*, others to the *Liver*, and hinder them from performing their uſual office; ſo the *Poppy*, *Mandrake*, *Saffron*, &c. have a ſenſible power of obſtructing the ſaid *Contexture*, and cauſing fewer *Spirits* to be tranſmitted from the *Heart* to the *Brain*. For all *Somniferous* or ſleeping things, whether outwardly applied, or taken inwardly, infuſe a certain moiſtning all over the *Body*, and ſo induce a Refrigeration or Cooling, by which the abundance of *Spirits* is diminiſh'd, or their *motion* retarded. By the like Reaſon, thoſe who are troubled with a *Catarrh* or *Rheum*, are apt to fall *aſleep*, and to be oppreſt with a kind of ſtupidity or heavineſs, by reaſon of the abundance of *Humour* which lies about the *Fountains* of the *Nerves* and ſtops their paſſages.

VI. *Why Baths excite to ſleep.*

Balneo's generally cauſe *ſleep* in thoſe that uſe them.

This they do, not ſo much from the immediate virtue of *Bathing*, but ſo far as they communicate to the *Humours* circulating through the *Pores* certain ſweet *particles* proceeding from thoſe emollient *Herbs* infuſed in the *Bath*, whereby it comes to paſs, that the *Blood* is ſomewhat reſtrained, and diſturbed in its *over-violent* Career, ſo as that it drives not into the *Brain* with ſo much vehemence as before, nor is there ſo great a quantity of *Spirits* to be diſcerned, from the want whereof *ſleep* ariſes.

VII. *How the Lethargy induces ſleep.*

Certain *Diſeaſes*, as the *Lithargy* and others, create in the Patient an exceſſive drouſineſs, and at length plunge him into a deep *ſleep*.

And this by reaſon that the proximate cauſe of this *affection* is the obſtruction of the *Pores* of the *Brain*, proceeding from a groſs *Humour*, and the want of *Animal Spirits* immerſt in the overflowing ſtagnation of *Humour*, by which means thoſe affected with this *Diſtemper*, muſt needs be apt to fall *aſleep*. And ſuch a *ſleep* it is, that it may be accounted not only the Chain and Fetter of all the exteriour *Senſes*, but alſo the Oblivion of all things. Wherefore thoſe that have taken in the *Infection* of the *Plague*, if they are of a ſleepy Conſtitution, and give themſelves up to repoſe, become the more deeply infected, and Nature is the leſs able to reſiſt the *Contagion*. Moreover, thoſe that have drunk *Poiſoned Potions*, if upon the drinking of them they are overtaken with *ſleep*, they ſuffer in a higher degree, and the *Poiſon* the ſooner reaches their *Vitals*. Becauſe too much evaporation oppreſſes the *Natural Faculties* and renders them dull, heavy and uncapable of overcoming the *Evil*.

VIII. *Why the Cock wakes at Midnight.*

The wakeful *Cock* certainly ſhakes off *Sleep* about *Midnight*; Whence MANTUAN,

The Bird that's ſacred to the Sun's bright Ray,
Bids Night adieu, ſalutes th' approaching day.

Cicero in his 2*d* Book of *Divination* judges DEMOCRITUS to have moſt excellently explain'd the reaſon why *Cocks* Crow before *Day*, as follows, *The Meat being gone off from the Stomach, and diſpers'd into the whole Body, the Cock*, ſaith he, *in the ſilence of the Night, having digeſted his Meat, and being ſatisfied with reſt, to expreſs his content, lifts up his Crowing Voice, and diſplays his Gay Wings.* But with this opinion of *Democritus* I am no way ſatisfied. Becauſe if the *Cock* rowſes from *ſleep*, and *Crows* after Midnight, by reaſon of the digeſtion of his *Meat*, it ſhould follow from thence, that afterwards he would no more indulge to reſt; but this Experience contradicts. Beſides, he *Crows* as well at Noon, being full, as alſo after treading of the *Hen*; ſo that this Reaſon might better be given, namely, that the *Sun* having paſt the *Nights Meridian*, and now ſteering towards the *Morning*, agitates and drives before him a cold *Nocturnal Gale*, by the ſhuddering approach whereof the *Cock* being rouſed out of his *ſleep*, flutters with his *Wings* and ſets a *Crowing*.

Or why may we not affirm, that certain times are allotted to all *Creatures* for *ſleep*, and this particularly to the *Cock*, at which by an innate motion it wakes, and having its *Spirits* in agitation, ſets a *Crowing*, and by his *Crowing* teſtifies his wakefulneſs? For why may not the *Spirits* of the *Cock*, as well as of a *Gooſe*, or any other Bird of that Nature, incloſed in the *Brain*, excited either by its own abundance, or by ſome external murmuring noiſe, ſo open thoſe paſſages in which the ſaid *Spirits* uſe to have their courſe from the *Brain* to the proper *Organs* of the *Senſes*, as from the Center to the Circumference, as by a concourſe made to move the *Nerves* attendant to the foreſaid motions?

IX. *Why we are moſt apt to be ſleepy after Meals.*

Soon after Dinner or Supper we are more apt to fall *aſleep* than at other times. Whence many have taken up a cuſtom of ſetting themſelves to *ſleep* after *Meat*, to which Cuſtom Nature ſeems to invite, and few can put it off without much reluctance.

The Reaſon is to be derived from the very concoction of the *Meats*; for when at that time a cruder *Chyle* from the *Stomach* and the *Inteſtines* is mingled with the *Blood*, and hinders the rarefaction thereof, it muſt needs follow that the *Brain*, by the loſs of *Spirits*, is refrigerated at that time, and ſo contracts a certain *ſleepy* diſpoſition, ſo that the *Spirits* which remain are ſcarce ſufficient to keep the paſſages of the *Nerves* open and tite: Hence we find by experience, that the external parts of the Body are after Meat refrigerated, ſo that the Head hangs down, and the Eyebrows fall, if we do not rouze and ſet upon ſome ſerious affair, and find work for the *Animal Spirits*.

Sleep

X. *How it comes that we are more apt to wake out of our Sleep by Night than by day.*

Sleep is not ſo eaſily broke off by *Day* as by *Night*, as we find by experience in the *Spring* and *Summer*, in which, by reaſon of the *Suns* light coming in at the *Chamber Window*, we are more difficultly rous'd from *Sleep* than in the *Winter* when the *Sun* is at a diſtance, and we are ſurrounded with *Miſt* and *Darkneſs*.

This proceeds not from *Light*, as from the efficient Cauſe; as if *Light* were indued with a faculty of procuring *Sleep*; but only by accident, foraſmuch as our *Eyes*, being weak, and ſmitten with ſudden *cold*, are apt to wink, and at laſt to cloſe and be quite ſhut: For when we open our *Eyes*, the *Light* comes upon them, and ſmites them, and they not knowing how to ſend back the *Rays*, are offended and diſturbed to be ſo ſmitten by them, ſhut down the *Eye-lids* again, and betake themſelves immediately to a renovation of *Sleep* and *Repoſe*. Hence it comes to paſs that *waking* at broad day, and opening our *Eyes*, we feel a kind of force and pain in ſo doing; in regard the Light ſmites not the *Retine Tunicle* by degrees, but all on a ſuddain.

XI. *Why the extream parts of our Body are apter to be cold in ſleep than when we are awake.*

When we are *aſleep*, we are more apt than at other times to be *cold* in the extreme parts of our *Body*, but hot within.

This moſt probably proceeds from hence, namely, for that the *Blood* not being at that time agitated by any *paſſion*, or any violent *exerciſe*, flows ſo quietly that it hath not force enough to convey any *heat* to the extremities of the *Body*, whence they become *cold*, at leaſt in thoſe perſons whoſe *Lungs* are in a good temper: But for thoſe that are troubled with bad *humours*, or are *Aſthmatick*, they cannot indure to lie covered, by reaſon that the heat which they bring upon themſelves by being covered, very much augments their inward heat.

XII. *Why thoſe that lie ill at eaſe, are eaſily wakened.*

Thoſe that lie not at eaſe, by reaſon of the *Sheets* not lying ſmooth under them, or the hardneſs of the *Bed*, or a neceſſity of making *Water*; are very often interrupted in their *Sleep*, and forc'd to lie awake a long time.

The Reaſon is, becauſe the *Animal Spirits* which are bred during *Sleep*, and continually repair'd by the motion of the *Blood* through the *Heart*, can have ſuch a plentiful confluence, as that having thereby the power of opening the *Orifices* of the *Nerves*, they fill them in ſuch a manner as is neceſſary to extricate their *Filaments*, and give occaſion to the *Soul* to perceive thoſe *Objects*: For whatſoever gives diſturbance to any *ſenſe*, and interrupts the uſual rate of *motion*, is an abſolute Enemy to all *Repoſe*.

XIII. *Why attentive reading after Meals, induces ſleep.*

We find by experience, that when we are very attentive in *Reading* or *Studying* preſently after *Dinner* or *Supper*, we are apt to fall *aſleep*, but not in the leaſt when we are preſent at the acting of a *Comedy*, or the ſight of any thing that moves to *Laughter*.

The Reaſon is, becauſe any ſtudious attention, or ſerious exerciſe of *Mind*, draws the *Blood* more copiouſly toward the *Head*, and gathers it together from all parts of the *Body* towards the very midſt of the *Brain*. By which means it comes to paſs, that upon the *Blood* penetrating the *Brain* there follows a great recourſe of *Nervous Juice* that way, by which the *Spirits* are preſently obſtructed, and their intermediate places taken; but it falls out otherwiſe, when after *Dinner* we repair to a *Comedie*, becauſe then the *Animal Spirits* being diffuſed with pleaſure, diſtend and enlarge the *Brain*; ſo as that the paſſages being ſtreightned by that inflation, ſtop the courſe of the *Soporiferous Humour*, and hinders it from forcing into the *Brain*.

XIV. *How Coffee happens to drive away ſleep.*

Coffee is ſaid very much to keep away *ſleep*, and procures an extraordinary diſpoſition to *wakefulneſs*, and an unwearied exerciſe of the *Animal Faculty*; foraſmuch as upon the drinking of this *Liquor* any one may ſit late at night for the carrying on of any Studious Contemplative or Wakeful buſineſs.

This effect in my Judgment may very well be imputed to thoſe aduſt *particles* of the *Coffee*, which mingling firſt with the *Blood*, then with the *Nervous Juice*, keep by their agility and reſtleſneſs the *pores* of the *Brain* open, and the *Spirits* having now ſhaken off all Curb or Bridle, are prick'd as it were with *Goads* and *Stimulations* to the longer and more continued performance of their *Offices*. In like manner the Cauſe of a very wakeful temper may be imputed to a torrid and *Melancholick Blood* which ſupplies the exteriour *Brain* with ſuch a ſort of *Nervous Juice* as is parch'd and fill'd with aduſt *particles*, and is neither fit to remain longer within the *pores* of the *Brain*, nor kindly to receive and contain the *Animal Spirits*.

XV. *In what the exceſs of Coffee is hurtful.*

This kind of Drink, tho' of very common uſe, and in ſome caſes very wholeſom and medicinable, yet at other times, and in other caſes it may be hurtful and unwholeſom; and this not only *Reaſon*, but alſo common *Obſervation* tells us; foraſmuch as exceſſive *drinkers* of *Coffee* are very often *Lean* and *Paralytick*, and many times unapt for *Generation*: In regard, ſince the *Blood*, by the frequent and exceſſive uſe thereof, becomes in a great meaſure acid and aduſt, it is conſequently the leſs apt and capable to nouriſh.

XVI. *How it is that Children are rock'd aſleep by the motion of Libration.*

In *Children Sleep* is procur'd by the motion of *Libration*, ſo called, or rocking in a *Cradle*.

The *Reaſon* is, becauſe this *rocking* to and again ſtirs the Humours of the *Brain*; by the acceſs of which Humours to the *Brain* and Origin of the *Nerves*, *Obſtructions* are created: As when any ſort of *Liquor* is injected with a force upon whatſoever *Object* is capable to receive it, it ſinks in the deeper, eſpecially if the *Body* into which it enters be tender and ſoft, as the *Brain* of *Children* moſt certainly is.

XVII. *How ſome duly come to wake at ſet hours.*

Some wake conſtantly at ſet hours.

This comes to paſs, partly by reaſon of daily cuſtom, and partly becauſe at certain ſet *hours* thoſe men have ſufficient plenty of *Animal Spirits* to puff up the *Tubes* of the *Nerves*, and alſo the *Muſcles*; as appears in thoſe that are more *hungry* at ſome times than others: Of which there can be no other reaſon given, than becauſe by that ſet time the *Blood* has made ſeveral *circulations* through the *Heart*, and by that means hath obtained ſuch a due degree of acidity, as is requiſite for the exciting of *Hunger* in the *Stomach*.

XVIII. *How many hours are to be allotted for ſleep.*

As for the time allotted for *Sleep*. That which the *Schola Salernitana* hath decreed in this point, is moſt generally received.

Seven hours in Sleep the Eyes to hold,
Is long enough for Young and Old.

But in this matter a certain ſet time cannot be appointed to all alike, but rather the different *temperament* of this or that *perſon* is to be conſulted. For to thoſe whoſe *Blood* is more thin and ſubtile, as the *Spaniards*, *Italians* and *French*, a ſhorter time of *Sleep* is ſufficient; for example, the ſpace of five *hours* or thereabout, which would be too ſhort for thoſe that have their *Blood* more groſs and viſcous, for ſuch *Blood* ſhould be allowed time to paſs often through the *Heart* before it can be made thin enough to afford matter for the generating of *Spirits*.

CHAP. X.

Of the Diſeaſes, and Death of Animals.

I. *What the Cauſe of Diſeaſes is in Animals.*

THERE are no *Creatures* whatſoever totally exempted from *Diſeaſes*, but according to their different temperament are affected with ſome or other *Bodily Diſtempers*. Some are troubled with a Shaking or Trembling of their *Limbs*; others are in a manner choak'd up with an Inflammation of the *Jaws*, commonly called a *Quinſie*; others are afflicted with the riſing of the *Lights*, &c.

The Reaſon is plain, becauſe *Sanity* or *Health* is a certain diſpoſition of the *Body*, by which it is rendred capable to perform its Offices. So that when-ever the temperaments of the parts chance to be altered, or its *Organs* to be intercepted, the Order or Courſe of Nature being hereby inverted, the *Creature* muſt needs be deprived of *Health*, as falling from its primitive State of *Body*. So the *tremour* or *ſhaking* of the *Limbs* proceeds from a debility of the *Nerves*, or ſome depraved affection which haply ſome foregoing *Convulſion* had left behind it; or by reaſon of ſome *frigid Humour*, which inſinuating through the hidden paſſages, impells the *Members* to this motion. So the *Quinſie* in ſuch ſort ſtreightens and ſhuts up the *Jaws* of ſome perſons, that they are hardly able to breath, much leſs to ſwallow any thing, by reaſon the *Inflammation* or malignant Humour ſo wholly takes poſſeſſion of the *Nerves*, that they are rendred in a manner uncapable of *motion*, and ſcarce ſufficient for the opening of the *Jaws*: So the *riſing* of the *Lights* is incident to thoſe whoſe *Stomach* is obſtructed by certain *humours*. For ſince the *Blood* is ſtrained through the *Liver*, it may very well ſo happen, that that which is tranſmitted from the *Milt* through the *Splenick Veſſel*, or flows from the *Meſentery* is corrupted and ſhuts up the *pores* through which it is to paſs. In like manner we may inquire into the reaſon of any other *Diſeaſe* which is incident to *Animals*, ever perverting or diſturbing their *actions*, and hindring their *faculties* from performing freely the *offices* of *Life*.

II. *Whence it is that the pain of the Teeth is ſo ſharp and vehement.*

The *pain* of the *Teeth* is a moſt acute and ſenſible pain.

It is not to be imagined, that the *Teeth* have any ſenſe of *pain*, ſince they are all Bone and ſolid: But this *pain* vulgarly aſcribed to the *Teeth*, proceeds from thoſe *Nerves* which terminate at their Roots, and the pain is the greater, Firſt, becauſe thoſe *Nerves* being of a very ſhort extent, ſo much the ſooner tranſmit the impreſt motion to the common *ſenſorium*. 2*dly*, Becauſe they happen to be overmuch ſtretcht, whereupon that action of the *Internal Object* is the more lively propagated. As we may obſerve in *Muſical Chords*, that thoſe which are ſtretcht to the higheſt pitch, give the acuteſt or higheſt *ſound*. 3*dly*, Becauſe they go right forward without any deviation, by which means the impreſt motion is carried the more eaſily to the inmoſt parts of the *Brain*, as appears in the difference between a *Rope* drawn out into a ſtrait *Line*, and another laid crooked or winding. But this moſt acute *pain* of the *Teeth* uſually ceaſes upon drawing out of the *Tooth*, in regard by this means the over-much tenſion of the *Nerves* is remov'd, by reaſon whereof the impreſt motion cannot continue to be tranſmitted ſo vivaciouſly to the *ſenſorie*.

III. *Why ſome Infants die with breeding Teeth.*

Hereupon it is that *Infants* die through the exceſſive *pain* of *Teeth*, which when they begin to breed, they by the violence of their crying ſo exceſſively ſhake the *Brain*, and the *Membrans* covering it, which are very ſoft and tender, that all the natural *faculties* of the *Infant* are exceedingly diſturbed and out of order, whereupon the *Milk* and *Blood* become corrupt, and the *Spirits* bred of them, contract an acrimony, which entring into the *Nerves* through the *Muſcles* excite them more than ordinary, and cauſe *Convulſive Fits*, of which they oft die, becauſe the efforts they make, cauſe the *blood* to flow in ſuch abundance into the cavities of the *Heart*, that they become too inflate, and cannot give it a free courſe, and continue that *circulation* which is neceſſary for *Life*.

IV. *Why the Small Pox and Meaſels are ſo common.*

The *Small Pox* and *Meaſels* are incident to all perſons, and moſt eſpecially when they are *Children*, but if not then, yet at leaſt at ſome time or other of their *Life*.

This is becauſe they brought into the *world* ſome impure *particles* which lie skulking here and there in ſome lurking places of the ſolid parts, and which in proceſs of time are drawn forth from thence by a ferment or peculiar matter of the firſt *Element* introduc'd by *fermentations*, and are pour'd upon the maſs of *blood* in which they excite a violent motion, until at length they are caſt out through the *pores*, and appear upon the ſuperficies like little ſmall *Veſicles* or *Bladders*. Thoſe that have but few *feculencies* ſtagnating in the *Body*, are for the moſt part but lightly inveſted with them; thoſe that have none of theſe *feculencies*, are never troubled with this *Diſtemper* during their whole *Life*, but there are very few that eſcape. Thoſe that once have them very much, ſeldom have them again, which is a great ſign that the place which gave harbour to the Peccant Matter, is totally clear'd and empty'd thereof. But thoſe who, who having in their *Bodies* a plentiful ſtock of this ſaid matter, yet have put forth but few, are in much danger of being infected with them a ſecond time, if not a third. Theſe *Diſtempers* are epidemical, and ſweep away yearly, eſpecially out of all great *Towns* and *Cities*.

V. *Whence it happens that ſome feel greater pains at one time than another.*

Many feel great pains returning yearly at ſome ſet time, eſpecially ſuch as proceed from old *Wounds*, or ſome acute *Diſtempers*, which, tho' cured, yet leave a remembrance behind them.

The Reaſon ſeems to be this, becauſe in the ſcars which thoſe *Wounds* have left, the *pores* are very much altered,

altered, both as to their *Magnitude* and *Figure*, and wholly different from the *pores* of the reſt of the *Body*. When therefore any change of *Air* or *Seaſon* is at hand, another *Æther* uſually approaches our *Earth* than before, which ruſhing into the *pores* of our *Body*, eaſily paſſes them all, thoſe only excepted which are in the Scar of the *Wound*, in regard they have a perfectly different *Figure* from any of the reſt; whereupon the ſaid *Æther* muſt needs make a more forcible entrance into the intorted *pores* of the *Scar*, and conſequently excite a Vellication and Senſe of *Pain*.

VI. *The Original of the French Pox.* The *Diſtemper*, commonly called the *French Diſeaſe*, had its beginning among the *French* at the *ſiege* of *Naples*, being till then unknown to all but the *Canibals* of *India*.

The Cauſe of this ſo foul and poiſonous a *Murrain*, the *French* aſcribe to certain *Mariners*, who coming from *Mauritania* to the ſaid *Siege* to vend their *Merchandiſe*, ſold inſtead of the *Sea Hogs* the *Fleſh* of *Men* newly killed, ſalted and barrelled up. Which ſort of *Meat* the *Soldiers* feeding very much on, contracted this *Diſeaſe*, which afterwards ſpread very much by *Contagion*, and infected thoſe *Women* with whom they had to do. Nor is this Reaſon of the *French* any way diſſonant from truth, ſince certain it is that the *Canibals* who feed upon *Mens Fleſh*, are greatly puniſh'd with this *Diſeaſe*. And *Hiſtory* teſtifies, that the *Indians*, when firſt diſcovered, were known to have this *Venereal Diſtemper* frequently among them. Becauſe the *Eating* of *Human Fleſh* begets foul and fulſom *Vapours*, by which the *Head* being wrought upon is Vitiated, and the contexture of the *Fibres* of the *Brain* corrupted.

VII. *Why Men in a Fever are reſtleſs.* *Perſons* in a *Fever* are wont to lie all night as if they were ſound *aſleep*, when in the mean time they have not one minutes reſt, but lie muttering to themſelves, and in a very reſtleſs condition.

The Cauſe is to be ſought from the *pores* or *tracts* in the *Brain*, by which the *Animal Spirits* are conveyed to the *Brain*, which are very much obſtructed by a certain groſs matter which proceeds from the *maſs* of *Blood*, in regard the *Spirits* being at that time not allowed their wonted dilatation, a heavineſs to *Sleep* ſeems juſt falling upon them; but by reaſon of certain acid or aculeated *Corpuſcles* adhering to the ſaid *Spirits* which put them into motion, It happens that ſome of them break the way, tho' barricadoed or ſhut up, and ſtumble upon each other by an oblique courſe. Whereupon ſo great an agitation of them, tho' confuſed, by reaſon of the divaricated obſtacles, cannot but diſturb the quiet and ceſſation of the *Animal Function*.

VIII. *Why in the Palſie the Body drys and falls away.* In a *Palſie* the parts being looſened, pine away, and by little and little conſume, till at laſt ſcarce any thing is left but *Skin* and *Bone*; altho' the *Blood* at the ſame time have a free and plentiful courſe, and circulates after its wonted manner through the whole *Body*.

The Reaſon hereof muſt be ſuppoſed to be, for that in this *Diſeaſe* the *Nerves* are ill-affected, and cannot perform their office, for the *Blood* is not, as ſome of the *Ancients* believed, an adequate nouriſhment of the parts of the *Body*, but a certain *Juice* transfuſed to them from the *Brain*, and the *Medulla Spinalis*, by the mediation of the *Nerves*. So that ſince in *Paralyticks* or thoſe troubled with the *Palſie*, the *Nerves* are obſtructed, and can no longer ſupply nouriſhment; no wonder if in that *Diſeaſe* the parts of the *Body* dry and wither, and the fleſhy ſubſtance falls away. Hence it comes to paſs, that thoſe who have *ſpongy* and *moiſt pores*, by reaſon of their reception of their greater plenty of *Alimentary Juice*, grow fat: But thoſe on the other ſide are apt to be lean who abound with *Blood*; yet by reaſon of overmuch *heat*, have their paſſages ſtraight, and their *Nerves* not wide enough for the drawing in of *Juice*.

IX. *How ſome Diſeaſes come to be more tolerable than in former times.* The *Elephantiaſis*, or vulgar *Leproſie*, as alſo that which is called *Stomacace* and *Scelotyrbe*, are now much more mild and gentle than in former Ages, in which perſons were wonderfully tormented and felt intolerable pains.

The Reaſon is, either becauſe the rigor of the *Diſtemper* is much taken off by powerful *Medicaments* now better known than formerly, or becauſe Nature accuſtomed to thoſe *Diſtempers*, hath induc'd ſuch a Calloſity, that they ſeem now more tolerable than of old, and ſo much the more tolerable by how much they have been the longer indured. The Reaſon whereof may poſſibly be, becauſe the *Ardour* and *Ebullition* of the *Diſtemper* is diminiſh'd. Or elſe Nature accuſtomed to a pain of ſo long continuance, ceaſes any longer to ſtruggle ſo much with it, as being now familiar, and as it were domeſtick: Or Laſtly, Being nouriſhed even by thoſe corrupt *humours* is the leſs offended by them. For even as thoſe naſty ſorts of *Fellows* that empty *Houſes of Office*, and cleanſe *Sinks* and *Common Sewers*, are made by long cuſtom unſenſible of the filthy *ſmell*: So thoſe that are *diſeaſed*, for examples ſake with the *French Pox*, after they are uſed to it, as if they had loſt their *Senſe*, are no longer ſenſible of the defects of the *Body*, and debilities of *Nature*; by reaſon that *Nature* and the *Diſeaſe* grow at laſt to be of a party and agree together, and the *Humours* of the one are mixt with the *Humours* of the other.

X. *Why Pain increaſes at Night.* When *Night* comes, *pains* increaſe, and are exaſperated to a greater heighth.

The Reaſon is, for that the *Humours*, quiet before under covertures and bindings, are mov'd and ſtirr'd up, ſo that thoſe *Acid Particles* formerly impriſoned, take thenceforth an occaſion to *Vellicate*, more than before the *Nervous Fibrils* of thoſe parts in which they are fixt. Whence there muſt neceſſarily follow a notable aggravation of *pain*; as appears in thoſe who are diſtempared with the *Venereal Diſeaſe*.

XI. *Why ſome ſort of Fevers begin with Cold.* Some *Fevers* (or rather *Agues*, for ſo they are commonly called in *Engliſh*) begin with *cold*, in ſuch ſort, that not only the extream parts of the *Body* are ſeiſed with *cold*, but with a certain kind of Action of Horror, the whole *Body trembles* and *ſhakes*.

The Reaſon is, becauſe *Fevers* proceed from a certain *Humour* falling into the *Meſentery*, or ſome other part of the *Body*, which *Humour* flowing through the *Veins*, and by that means mixing it ſelf with the *Blood*, is at length conveyed therewith, to the *Heart*, which gives an obſtacle to the *Blood* from being heated there, and dilated as before, and conveys that heat which it borrows from the *Heart* to other parts of the *Body*. Whereupon a cer-

a certain *tremour* muſt needs ariſe; and the *Febricitant* or *Fever-ſeiſed* Perſons be taken with a ſuddain *ſhaking* of the *Members*: Which yet never happens, but at the beginning of a *Fit*. For as *Green Wood* thrown upon a *Fire* puts it out, or at leaſt oppoſes, and reſiſts its *heat*, but being once kindled, ſends forth a fiercer flame than any other *Wood*: So after that the ſaid *Vitiated Humour* hath been for ſome time mixt with the *Blood*, it grows hot at length, and is dilated in the *Heart* more than the *Blood* it ſelf. And this cauſes the return of the *Fit*, which laſts ſo long, till the ſaid corrupted matter is exhaled and reduced to the natural conſtitution of the *Blood*.

XII. *Whence the diverſity of Fevers ariſes.*

Fevers, which are ſo very incident to *Mankind*, afflict not the *Body* always after the ſame manner: For ſome affect with a *continual burning* or violent *heat*; others *intermit*; ſome return more ſuddainly, ſome more leaſurely, and ſome anticipate and come before their uſual time.

The difference of all theſe *Fevers*, ariſes from the *Morbifick Matter* which creates the *Fit*. For tho' that *Matter* in the former *Fit* hath been all purg'd away, yet there ſtill remains ſome fewel or depraved diſpoſition in that place wherein the *Humour* was firſt vitiated. Whence it comes to paſs, that that which ſucceeds there anew, is firſt coagulated, then corrupted, and after ſome certain time growing to maturity, flows toward the *Heart*, in the ſame manner as the former, and creates the ſame ſymptoms. Whereupon, if the *Morbifick Humour* which ſucceeds into the ſame place wherein the former was corrupted, wants the maturation of three days, before it mix with the *Blood*, it produces a *Quartan Fever* or *Ague*; if it ſtand in need of two only, a *Tertian*: But when the ſaid matter applies to the *Heart* with a continual onſet, and vellicates or twitches it without ceaſing, it induces a *Quotidian*, or continual diſtemper. *Laſtly*, If the *Blood* be ſo vitiated, that between the time wherein the laſt drop of the depraved *Humour* flowed out, and that wherein the firſt drop of the new gathered *Humour* began to take its courſe, it cannot be purified, the *Fever* renues with a more ardent inflammation than ever.

XIII. *How a Fever ariſes ſometimes from Pain.*

Beſides all theſe ſeveral kinds of *Fevers*, *Phyſitians* obſerve that a *Fever* ſometimes proceeds meerly from a previous pain.

The Reaſon of all this we ſhall ſoon underſtand, when we conſider that *pain* hence ariſes, namely, for that the *Fibres* of the *Parts* incur danger of Ruption or breaking, if not Ruption it ſelf. Whence *ſenſation* of *pain* ariſes in the *Mind*, which is followed by an immoderate influx of the *Spirits* into all the *Nervous Tribe*; ſince therefore many little Branches of the *Nerves* are implanted into the *Arteries*, and feel the ſaid inordinate influx of *Spirits*; hence it comes to paſs, that the *Arteries* are hurtfully ſmitten and battered, and that the *Blood* contained in them is wonderfully ſtreightned and pent in, and its mixture confounded and diſturbed. And hence it is that the *Fever* ariſes.

XIV. *Why after the fit of a Fever the whole Body is in pain.*

After a fit of the *Fever* we feel a pain all over the *Body*.

Becauſe ſince the *Feveriſh Heat* which uſes to ſucceed the ſhakings and *cold fit*, depends meerly upon this, namely, that the *Blood* by means of this admixture of the *Febrile Matter*, riſes into a preternatural and vehement heat and ebullition, as moiſt and green Sticks of Wood laid upon a *Fire*, do not very eaſily catch, and burn into a blaze, but when they have once taken, caſt a moſt ardent heat above all the reſt of the fewel: Hence it is that by this great efferveſcence of *Blood* within the *Heart*, the *particles* thereof are more ſubtiliz'd, and as if abundance of *Salt* were mixt with it, the ſaid *Blood* makes an irruption into the *Fibres* of the ſolid parts, and by corroding them, creates that *pain* which ſo afflicts us after the *Fit*.

XV. *The Head-ach hath alſo its acceſſes at a certain time.*

The like diſſertation we may make concerning the periodical acceſſes of the *Head-ach*, which are *daily*, by reaſon of the *Morbifick Matter* riſing and boiling up to a heighth at a ſet time. But ſo far *varying* as to be either before or after *Meat*, according as the offices of *Digeſtion* and *Diſtribution* of the *Aliments* are ſooner or later performed.

XVI. *Why ſick perſons grow lean.*

Thoſe that are ſick of a *Fever*, and oppreſt with an exceſſive and unwonted Heat, *Leanneſs* and *Conſumption* attend them.

The Reaſon is, becauſe the *particles* of the *Blood*, or *Nutricious Juice* which are for the *nouriſhment* of the *Body*, and ought to make ſome ſtay in the *Members*, to which they take their courſe, are more haſtily moved and agitated, than to be able to make their due ſtay, and afford their due *nouriſhment*, but either are thrown off by thoſe *Members* in a nature of *Sweat*, or paſs away by inſenſible *Tranſpiration*; whence the *Body* muſt needs be exhauſted and become thin and lean for want of *nouriſhment*: Juſt as *Plants* are dried up and wither, when by the overmuch heat of the *Sun*, the *Juice* aſſigned for their *nouriſhment* is too quickly ſtrained within their *pores*, and without making that ſtay there which is required, paſſes away and drops off.

XVII. *Whether Diſeaſes can be known by the Urin.*

Some there are that pretend to know all *Diſeaſes* by *Urines*, as commonly your *Quacks* and *Mountibanks*, and ſome reputed *Phyſitians* are not aſhamed to undertake the ſame thing; nay they go ſo far as to make us believe, that they can tell the *Diſeaſes* of each part of the *Body* by the *Urin*, and whether it be the water of a *Young Man* or an *Old*, of a *Man* or a *Woman*, of a *Woman* with *Child*, or not with *Child*. But theſe things I look upon as trifles, for how can it be reſolved from the *Urin*, whether the *Eye akes*, or the *Noſe*, or the *Ear*? Whence the *Head-ach* ariſes? Whether there lie any obſtructions there undiſcovered? whether there be any *Diſtemper* in the *Arms*; whence its pain comes? For that all theſe things are impoſſible, both Reaſon and Experience teſtifie. I confeſs indeed that ſomething may be conjectured from *Urines*, but it can be nothing but what is very general. So if *Matter* be voided together with the *Urin*, we may conclude that there is ſome part *Ulcerated*, but what part that is, who can reſolve? For we ſee that *Matter* is voided when the *Lungs* or *Bowels* are *Ulcerated*; and tho' the *Urin* paſſes through theſe *Ultimate Parts*; yet it is a difficult thing to reſolve whether it proceeds from the *Reins* or from the *Bladder*. This is certainly found by experience, that *Phyſitians* are very often deceived in this matter. Our judgment therefore of *Diſeaſes*, eſpecially of thoſe parts

parts through which the *Urin* paſſes not, ought not to rely upon the inſpection of the *Urin* only, but upon the indications that are to be gathered from complaints of the *Sick*.

XVIII. *Whence Deliriums ariſe in Acute Diſeaſes.*

Acute Diſeaſes are frequently attended with thoſe unſettlements of *Mind*, with which *ſick people* are mightily ſubject to be moleſted, and by which they are hurried into divers hurtful and unquiet thoughts.

The occaſion of this is, becauſe the *Animal Spirits*, which by chance, and without any deſign wander in the *Brain*, are carried by their own proper motions to open certain *pores* thereof, in the ſame manner as they were formerly opened at the preſence of ſome *Objects*; whereby it comes to paſs, that thoſe *Objects* are perceived under the ſame *Images*, as if they were really preſent, and ſo affect the *Soul* reſiding in the *Brain*, as if it were ſmitten by their *Species*.

So *Drunken Men* are affected with a kind of *Delirium*, while the *Spirituous Particles* of the *Wine* or *Beer* boiling by the heat of their *Stomach*, paſſes the *pores* of the *Brain*, and the *Spirits* reſiding therein take away the poiſe of the common *Senſorium*, which nevertheleſs was required, if a right determination of the *Animal Spirits* had been made by the *Soul*. But ſince the *Soul* is uncapable of governing all theſe *Spirits*, hence it comes to paſs, that they flutter up and down without any order, and without any determination of *Mind*, fall ſometimes upon theſe, ſometimes upon thoſe *pores*, which occaſions all thoſe antick poſtures, as *Dancings*, loud *Laughters*, idle *Songs*, &c. which are commonly taken notice of in *Drunkards*, which *actions* laſt ſo long, till at length, the choicer part of the *Spirits* being diſperſed, the common *Senſorium* hath its *Æquilibrium* or Poiſe reſtored it, ſo that the *Mind* can at pleaſure diſpoſe of the *Spirits* through the whole Body.

XIX. *How a Fever cauſes a Delirium in many People.*

Thus the *Blood* eſtuating in *Fevers*, cauſes either a ſimple *Phrenſie*, whether the *Blood* it ſelf takes *fire*, or carries along with it into the *Brain*, certain ſtrange and unruly corpuſcles, which enter the paſſages of the *Brain*, exagitate the *Spirits*, and either drive them into confuſion, or utterly overwhelm them, as commonly happens in *Drunkards*. Eſpecially if the *Brain* be weak and looſe, and the bilious *Blood* be turgid and ſwell with copious *ſulphur*. Neither are there wanting *ſaline* and *piercing Particles*, which enter the *pores* of the *Brain*.

XX. *How Animals come at length to die.*

Animals living ſpontaneouſly, freely and without any force upon them, are however at length taken away by *Death*. Becauſe the *Fermentations* in them grow daily weaker and weaker; hence firſt reſults a *groſs Chyle*, a viſcous and earthy *Blood*, and conſequently leſs moveable, and which introduces various obſtructions in the *Capillary Veſſels*. For as age comes on, the ſaid *Fermentations* are more and more diminiſh'd, and almoſt totally extinguiſh'd, whence there muſt needs ariſe a ſort of *Blood* yet much more *Earthy*, and ſcarce moveable out of its place. The *Fibres* and *Pores* of the parts are ſtreightned and grow ſtiff, and ſtill leſs and leſs admit of, and take in *nouriſhment*. Hereupon follow *Univerſal Obſtructions*, and by degrees all parts of the Body grow lean and waſte away, till at length the very ſnuff of *Old Age* brings along with it *death*, or a total diſſolution of the *Automatick Conjunction* in *Brute Animals*, but in *Mankind* a *ſeparation* of the *Soul* from the *Body*: For there is nothing ſo natural as that every thing ſhould be diſſolved in a retrograde order and manner to that wherein it was formed into a compoſition and ſubſiſtence.

The Ninth Part OF THE HISTORY OF NATURE. OF MAN.

CHAP. I.

Of the Sense of Touching, or Feeling.

I. *The Skin partakes more of the Sense of Touching, than all other parts of the Body.*

ALTHO' the Sense of *Touching* is spread all over the Body of *Man*, yet it is generally allowed that the *Skin* partakes more of this *Sense* than all the other *parts*, and the reason is, because the *Nervous Fibres* which are spread almost through all parts of the *Body*, run through the *Skin* in a particular manner, and in effect, the whole construction thereof is particular: For besides, that it is form'd of *Nervous Fibres* which are interwoven one with another, there spring from among these *Fibres*, certain small threds disposed into the form of *Pyramids*, and are *Nervous Eminences*, covered with a *Cuticle* or *Upper Skin*, under which is discover'd an *Oily Humour*, which keeps them always very supple. Whence it must needs follow, that the immediate *Organ* of *Touch* is no other than the *Nervous Fibres* extended all over through the *Skin*.

But this *Sense* of *Touching* or *Feeling* is chiefly predominant in the *hand*, as MALPIGHIUS confirms, who observed by a *Microscope*, that in the hollow of the *hand*, and the extremities of the *Fingers*, there were certain elevated wrinkles spirally drawn, in which were hidden those *Nervous Bodies* that serve for the act of *Touching*.

II. *Of a Woman, who after the cutting off of her Leg, complained of great pains she felt.*

A Certain *Noble Woman* in *Dauphiny* had one of her *Legs*, newly affected with a *Gangreen*, cut off, but with such Art and Industry, that she had not the least suspicion thereof, being deceived by a *Wooden Leg* which the Surgeons brought along with them, wrapt up in a *Cloth*; but some considerable time after the amputation, she complained of very sharp prickings and shootings, not only in her *Leg*, but down to her very *Toes* ends. Nor did she cease complaining after the matter discovered, but still asserted that she felt pain in her *Leg*.

The cause hereof can be no other than this, namely, that such is the constitution of our *Body*, that no part thereof can in the least be stirred by any other remote part, but it may also after the same manner be moved by intermediate parts, altho' the remoter conduce not at all to the motion: For who ever draws the last part of the given *Rope* A B C D, the first part A, will be moved in the same manner as it might be moved if it were drawn by one of the intermediates B or C, the last part D remaining unmoved; so when the *Noble Woman* felt the pain of the *Joints* of her *Leg* and *Foot*, the reason hereof was, because the *Nerves* which first descended to the *Foot* from the *Brain*, and were then terminated in the *Thigh* near the *Knee*, were there moved in the same manner as they were to have been moved before in the *Foot*, upon the sense of this or that *Toe* aking to be impresst upon the *Soul* residing in the *Brain*: Hence an Argument may be brought against the *Aristotelians*, who will have the *Soul* to be actually present in each part of the *Body*; for were it so, how could the *Soul* of this Lady judge her pain to be in her *Leg*, which was cut off, or in her *Toes*, when it was indeed in her surviving *Thigh*?

III. *How the Sense of Touching may be deceived.*

Thus it happens in us many times that when we lean longer than ordinary upon our *Elbow*, we feel a numbness in the *Little Finger*, so that the *Nerve* which is deduc'd from the *Brain* to that *Finger* being compresst more than it can indure, moves the common *Sensorium* with the like affection, as if it were prest in the said *Finger*.

IV. *Why any one touch'd on a suddain, hath a horror upon him.*

When any one, on a suddain, and having his *Mind* intent upon other things, is touch'd by any one, he is seised by a suddain trembling or horror.

The cause seems to be, upon an apprehension that by the said suddain *stroke* some mischief is design'd against him, whereupon he recollects himself, and indeavours to decline it. For then the *Animal Spirits* are suddainly stirred up, and tend in greater plenty to the *Brain* than that they can possibly be derived thence in order into the *Muscles*. For that which comes to the *Soul* by the *Senses*, affects it more, than that which is represented

ſented to it by reaſon, tho' for the moſt part it comes ſhort in truth and reality: Whence in regard by that unexpected *contact*, there is but a ſlight impreſſion made in the Body, and he finds the miſchief which he apprehended coming upon him, to be nothing but a vain apprehenſion, he returns immediately to himſelf, and after a little time lays aſide all horror.

V. *Why they who tickle themſelves, are not touch'd with horror.*

Hence it comes to paſs, that when we *touch* or tickle our ſelves with our own *hand*, we are not ſo ſhaken or ſmitten with *horror*, becauſe therein is no ſurpriſe, but we act at pleaſure, and conſequently following our own way and method, we are not touch'd with that apprehenſion of *evil*, which is the principal cauſe of the ſaid *Horror*.

VI. *Why Titillation is chiefly raiſed in the Soles of the Feet.*

Titillation is chiefly raiſed in the *Soles* of the *Feet*, which delighting the Patient by a grateful *Pruriency* or *Itching* affects him with a ſenſibility of *Pleaſure*.

Titillation is produc'd when the *Nerves* terminating in the *Skin* of the whole *Body*, are agitated more vehemently than ordinary. Yet ſo as that there follows thence nothing of *hurt*; or when the *Filaments* which are carried from the *Brain* to the other remoter parts of the *Body*, are drawn with the like force, ſo as they be not broken, nor divided from the *Members* to which they adhere; which *Titillation* or *Itching* is chiefly perceived in the *Soles* of the *Feet*, by reaſon of the tenſion of the *Skin* which is impell'd by a light contact, and tranſmits motion to the *Nerves*, the *Organs* of the *Senſes*: Or elſe, when through the unwontedneſs of the way of promoting the agitation of the *Spirits*, new force accrews to them. So a *Feather* or *Bulruſh* lightly running over the *Lips* or *Cheeks*, cauſes a *titillation* there, by reaſon of the thinneſs of the *Skin*, and the ſeldomneſs of any contact hapning in thoſe parts: Whereas if things harder than thoſe aforeſaid are applied, or the parts are more frequently touch'd the *Titillation* ceaſes; nor are thoſe parts affected in any unwonted manner. But the pleaſure which proceeds from *Titillation* hence ariſes, *viz.* becauſe the *Objects* excite a certain motion in the *Nerves* which might poſſibly hurt them, unleſs they had ſtrength enough to reſiſt it; or unleſs that *Body* were well diſpoſed, which cauſes ſuch an impreſſion in the *Brain*, which being inſtituted by *Nature*, to conteſt this good diſpoſition and ſtrength, repreſents it to the *Soul*, as a Good that belongs to it, ſo far as it is joined with the *Body*.

VII. *How it is that ſome certain Diſeaſes aboliſh all Senſe of Touch in Man.*

In perſons affected with the *Elephantiaſis* or *Leproſie*, and in ſome that are craz'd in their *Brain*, and are, as they are commonly term'd, beſides themſelves, the ſenſe of *Touching* is wholly taken away, tho' the *Locomotive Faculty* remains entire: For we often ſee *Madmen* go barefooted, and lie almoſt naked on the *ground*, their *Skin* being ſo benumb'd and ſenſleſs, that they hardly feel the inciſions of a *Knife*, or the running of *Pins* or *Needles* into their *Fleſh*.

This Caſe, tho' it be very difficult to unfold, by reaſon the *Nerves* convey both the *Inſtincts* of *Motions*, and the impreſſions of Senſibles to the *Brain*; yet it may be affirmed, that not the ſame *Fibres*, which attend upon *Motion*, are inſervient to the *Senſe*. For the *Muſculous* and *Tendinous Fibres* execute the motive power, but the *Membraneous* receive the ſenſible *Species*, and convey it to the *Brain*: So that it may poſſibly be, that the Hurt or haply the Loſs of the Senſe of *Feeling* may be cauſed by reaſon of ſome harm inflicted upon the exteriour *Members*; as namely, when their *Fibres* are overlaid by ſome groſs matter, or condens'd by exceſs of *cold*. On the contrary in the *Palſie*, it falls out that the Senſe, and not the Motion is hindred, in regard that not the ſame *Fibres* that are the *Organs* of Senſe are the *Organs* of *Motion*.

VIII. *How it is that the Skin being pulled off, Objects are felt more acutely.*

The *Skin* being pulled off from any part of the *Body*, *Objects* are the more acutely felt.

This happens, becauſe, tho' the *Cuticle* or upper *Skin* be interſperc'd with *Filaments*, by which the affection is tranſmitted to the *Brain*, yet it contains many inſenſible *Fibres*, which like *Dead Fleſh* are not affected by any Object. In ſo much that they may be taken off with a *Penknife* without any *Pain* or *Senſe*: Or at leaſt it may be made out that they are harder than to admit of any Impreſſion. For the *Interiour Fibres* which compoſe the *Fleſh*, being more tender and *nervous*, are therefore the more apt to admit even of the leaſt affection, and conſequently are the more ſharply prick'd with the aſperity of a *Body*.

IX. *How it is that any part of the Body becomes numb'd, or as they call it, aſleep.*

He who leans or puts a ſtreſs long upon any part of the *Body*, makes it ſtupid and numb'd, or, according to the vulgar expreſſion, *aſleep*; as hath been already intimated.

The Reaſon is, becauſe by the ſaid compreſſion the *Spirits* are ſtopp'd, and all acceſs to them obſtructed; whence it comes to paſs that when that part of the Body is relax'd, there is felt a little pricking, trouble or pain, by reaſon of the *Spirits* being at length agitated afreſh, and repeating their interrupted motion.

X. *That Males in* Winter, *and Females in* Summer *are moſt deſirous of Copulation.*

It is vulgarly affirmed, that *Females* in the *Summer*, and *Males* in the *Winter* are moſt deſirous of *Copulation*.

The Reaſon is, becauſe the *Bodies* of the *Males* being more hot and dry, the *Summer* hath more power by exhalation to diſſipate the *Animal Spirits*; whereas the *Winters Froſt* condenſes more, and preſerves them intire: For in *cold* and *moiſt Bodies*, ſuch as are thoſe of *Females*, the *Summers* heat cheriſhes, and calls forth the *Spirits*, when as *Winters* cold blunts and repels them.

XI. *Man excels other Animals in Feeling.*

Of all *Animals* whatſoever, *Man* excels in the faculty of *Feeling*, and more diſtinctly perceives the firſt qualities of things, and other qualities relating to *Touch* in general, as *Humidity*, *Siccity*, *Hardneſs*, *Gravity*, and the like.

This Prerogative we commonly attribute to the *Spider*, who (as the *Boar* ſurpaſſes in *Hearing*, the *Ape* in *Taſting*, the *Vultur* in *Smelling*) is generally believed to be the more quick and vigorous in the faculty of *Feeling*; but this vigorous ſenſe of *Touch* is upon no other account aſcribed to the *Spider* than upon its quick perception of *motion*, when ſitting in the midſt of its *Web*, it perceives the *Fly* lighting upon the moſt remote part thereof, which is not in the leaſt to be wondred at, ſince all the *Lines* are equal which are derived from the *Center*; ſo that lying in ambuſh in the middle, and holding the extremities of the *Threds* with its *Feet*, it eaſily deprehends all things which are tranſacted about it: But *Man* ſurmounts in the Prerogative of *Feeling* above all *Creatures*, by reaſon of the excelleent temperament of his *Skin*, and

and the ſubtile contexture of *Fibres* in which he excels all other *Animals*. His moſt excellent Faculty of *Touching*, is moſt chiefly diſcerned in the hollow of his *Hand*, and the extremities of his *Toes*, becauſe that in thoſe parts the *Filaments* of the *Nerves* are very ſlender, and moved with ſmall ado. Whence it happens, that, as it were by inſtinct of Nature, when we go about to grope out any thing by *Feeling*, we reach out our *Hand*, but chiefly make uſe of the extremities of our *Fingers*.

XII. *The Senſe of Touch is ſometimes augmented by the failure of the Senſe of Sight.*

The *Senſe* of *Touching* in ſome *Men* is ſo admirable, that it mightily helps the want of *Sight* in them, as appears moſt evidently in that renowned *Organiſt* of *Falcembourg*, who by his *Touch* alone, not only knew how to play moſt elegantly, but alſo could diſtinguiſh *Coins* and *Colours* of all ſorts from each other; nay, and to very great advantage plaid at Cards with other perſons, eſpecially if he dealt the Cards, ſince he could eaſily underſtand by the Pulps of his *Fingers* what ſort of Cards they were which he dealt to his Partners.

Of this thing there can be no other cauſe aſſigned, than becauſe all perſons, like the ſaid *Organiſt*, deprived of their *Sight*, are by conſequence no longer diſtracted by the multiplicity of external *Objects*, which hinder us from keeping our thoughts fixt upon any particular thing, ſo that by daily exerciſe, and a moſt accurate attention of all circumſtances, it muſt needs of neceſſity be that *Blind Men* muſt in the Senſe of *Touching*, for examples ſake, as in the reſt of the *Senſes*, of which they are not deprived, excel all other Men.

XIII. *How it is that in touching, the Object ſeems to be double.*

Touching ſometimes cauſes the *Object* to ſeem to be felt double, when as indeed it is but *ſingle*: For the *Globe* G, being touch'd with the two *Fingers* laid a-croſs D and A, feels like two.

The Reaſon is, becauſe while theſe *Fingers* keep themſelves thus croſſed, the *Muſcles* indeavour to deduce A into C, and D into F: Whence it happens that the parts of the *Brain*, out of which the *Nerves*, inſervient to theſe *Muſcles*, derive their original, are diſpoſed in ſuch a manner as is requiſite for the ſaid *Fingers* to be, *viz.* A into B, and D into E, and conſequently that the two *Globules* H and I, muſt ſeem to touch each other. For when we lay the *Middle Finger* A, for example ſake, upon the *Fore Finger* B, then the part of the ſaid *Fore Finger* B, which being next to the *Thumb* F, is diſpoſed together with the ſaid *Thumb*, to lay hold upon any thing, and the part of the *Middle Finger* A, which joined to the *Ring Finger* H, is apt, together with the ſaid *Ring Finger*, to catch hold on any thing, are not very capable, both at the ſame time, to graſp the ſaid *Globe*. And the *Mind* then ſeated in the *Glandule*, perceives the *Globe*, not as ſingle but double, and as it were placed in two places; and from the different Motion of the *Nerves* hath an apprehenſion of two *Globes*, not one.

Figure 28.

XIV. *How things appear double.*

By the ſame Reaſon, or not much unlike, when we hold up one *Eye* with our *Finger*, and behold any thing with diſſevered *Rays*, we cannot but perceive it as double: Foraſmuch as the ſuperior *Rays* of one *Eye*, are ever wont to act with the ſuperior *Rays* of the other; as likewiſe the Middle with the Middle, the Inferior with the Inferior, and to conſpire together to the perception of one and the ſame thing, as it were to make a report that it is indeed but one and the ſame. But if the *Eyes* chance by any means whatſoever, to be ſo diſtorted, that the Right *Rays* of one *Eye* agree not with the Left *Rays* of the other; or the Superior *Rays* of one with the Inferior of the other, all ſingle *Objects* whatſoever are look'd upon as divers. As in a *Concave Glaſs*, the Flame of a *Candle* appears double, by reaſon that from the Left Side of the ſaid *Glaſs*, the *Rays* are reflected into the Right *Eye*, and from the Right Side into the Left *Eye*.

CHAP. II.

Of Taſte.

I. *Why the ſame ſort of Meat is not always alike grateful to us.*

THE ſame ſort of *Meat* doth not always pleaſe. For that which is gratefully receiv'd by the *Hungry Stomach*, becomes unpleaſant and unſavoury to the ſame *Stomach* well ſatisfied; and the ſame *Drink* which delights the *Thirſty*, becomes loathſom to thoſe that are fill'd with *Drink*.

The Reaſon is, becauſe all *Savoury Things* impreſs an affection in the *Organ* of *Taſte*, according to the Contexture and diſpoſition wherewith it is imbued: So the *Tongue* over-dry, or void of Moiſture, perceives little or no *taſte* in any thing; and ſo on the contrary, a *Tongue* which is turgid or ſwelling with *too much Moiſture*, and hath its *pores* ſtopt up with *liquid Bodies*, cannot be affected with any *Savour*. Since therefore the diſpoſition of the *Tongue*, in a perſon *faſting*, and in a Perſon *full*, is quite different; hence it comes to paſs, that the ſame ſort of *Meat* or *Drink* is not always in the ſame manner received in its little chinks and ſmall *pores*, and conſequently induces a different affection therein. This may poſſibly ariſe from a Mutation of *Temperament*, whilſt the *Spittle*, proceeding from the *Stomach*, according to the *qualities* of the *Humour* wherewith the *Stomach* is repleated, mingles it ſelf with the *particles* of the *Meat* in the *Mouth*, and promotes their acting.

II. *The Groſs Error of the* Peripateticks *about Savors.*

This very *Experiment* alone is ſufficient plainly to diſcover how groſly the *Peripateticks* are deceived when they affirm, that the *ſavor* in *ſavory Bodies* does every way agree with the ſentiment we have thereof. Since were it according to their opinion, it would follow, that the ſame Man could not at ſeveral times have a different *taſte* of the ſame ſort of *Meat*, which is contrary to experience.

It may alſo happen, that from the various ſituation of the *Nerves* conducing to *Taſte*, all ſenſe of *Taſte* may be taken away, according to the mention made by REALDUS COLUMBUS, of one *Lazarus*, vulgarly Sirnamed the *Glaſs-devourer*, who not diſtinguiſhing in any thing *bitter* from *ſweet*, *freſh* from *ſalt*, uſed to devour *Stones*, *Glaſs*, *Charcoals*, *Fiſh* drawn alive out of a *Fiſh-pond*. Of which *Monſter* of *Nature*, when after his *death*, a Diſſection was appointed by a Perſon of Curioſity inquiſitive into the Cauſe of ſo uncouth a thing: It was found that the ſixth *Conjugation* of the *Nerves*, which was ordained by *Nature*, for *Taſtes* ſake in other Men, in this *Glaſs-devourer* reached neither to the *Palate*, nor

to

ro the *Tongue*, but turned back to the hinder part of the *Head*.

IV. *They that are troubl'd with the Jaundiſe, think all things they taſte to be bitter.*

They that are troubled with the *Jaundiſe*, think all ſorts of *Meat* they *taſte* to be bitter, and imbued with a quality noxious to them.

This miſtake proceeds from the *Choler* which is diffuſed through the *Tongue*, for ſuch a ſort of *humour*, mingled with the *Spittle*, infects the *Meats*, and imbues and depraves the *Organ* of *Taſte* with its *bitterneſs*: So that theſe Icterick Perſons are not ſo much deceived about the *Affection* impreſt (for they do really *taſte* that which is *bitter*, and the *Organ* is certainly ill affected) as about its Cauſe, ſince they look upon the ſaid *Savor* as received from the *Meat*, when as indeed it is to be imputed to the humour only. For ſome without any *Meat*, ſeem to themſelves to *taſte* a certain *Savor*, in regard this *humour* fliding into the *Tongue* or *Jaws*, vitiates and corrupts their *Temperament*. The ſame thing happens in the *Touch*, as when any one fancies he feels the force of *heat*, and thinks *Fire* to be applied to his *Body*, when indeed *Fire* is far enough off from it, and only a defluent humour, either a tenſion of parts alone, or a *tumor* with it impreſſes ſuch an affection, as *Flame* the *Inſtrument* of *Pain*, were it preſent, would impreſs.

V. *How it is that the Tongue diſcovers any diſeaſe.*

The *Tongue* is the chief Indicator of any *Diſeaſe*, and by whatſoever Infirmity we are oppreſt, 'tis thither we have recourſe for all the *Signs* and *Diſcoveries* thereof. In ſo much, that it hath been always the cuſtom of all *Phyſitians*, the firſt thing they do, to bid the *Patient* hold out his *Tongue*.

The *Reaſon* is, becauſe the *Tongue* being the tendereſt of all parts of the *Body*, is moſt eaſily wrought upon; for ſince it is of a Spongeous Nature, and abounding with *Blood*, it is ſoon ſeiz'd with the force of a *Diſeaſe*, or infected by vitiated *Blood*, by both which being ill-affected, no wonder if it ſoon diſcover the alterations of the *Body*, and reveal with what infirmities it is aſſaulted; ſometimes it looks *Red*, ſometimes *Yellow*; and when its plexure is ſingular, it is *ſubject* only to a ſingular affection.

VI. *They that eat Bread in a Morning, have a vellication at the root of the Tongue.*

They that take a *Cruſt* of *Bread* with a *draught* of *Wine*, for *Breakfaſt*, ſeem in a manner to feel certain prickles in the innermoſt receſs of the *Tongue*.

Becauſe the *Meal* of which the *Bread* is made, is for the moſt part kneaded with *Ferment* and *Salt*, the latter whereof ſtill imparts ſomething of *Acrimony*: For the *parts* immingled are rendred more ſharp, than thoſe that are more ſolute and looſe, and adhere to it with a leſſer tie. Whence *New Bread* pleaſes more, and is more grateful to the *Organ* of *Taſte*, in regard the *particles* thereof being leſs interwoven, are better chewed by the *Spittle*, and more gently move and affect the innermoſt tract of the *Palate*.

VII. *Why it is that thoſe who have no ſavor of Meats, ſeem alſo not to have any ſmell.*

They that have not the faculty of perceiving *Savors*, muſt in all likelihood be deprived alſo of the ſenſe of *Smelling*, as is many times obſerved in a Diſtemper called the *Poſe*, where the ſenſe of *Smelling* being taken away, that of *Taſte* alſo fails.

The Cauſe of this Conſequence depends upon the Corpuſcles which are inſervient to both *Senſes*; foraſmuch as they are the ſame, and differ in nothing but their various Expanſion. For the ſenſe of *Smelling* proceeds from *particles* of *Emanations* flying in the *Air*, which being mixt with the *Air* we breathe, are conveyed to the *Noſe*. But the *particles* which conduce to *Taſte* are indeed leſs ſubtile, and are to be imbibed by ſome humour, that they may ſmite the *Organ* of the *Tongue*; yet they are really the ſame, and are only diſtinguiſh'd in this, *viz.* that being diluted with *humour*, they cauſe *Savor*, and being exhaled and tranſmitted through the *Air*, they cauſe *Odour*.

VIII. *When Nauſeation comes, or a vomiting up of certain Meats.*

Many who have an averſion to certain ſorts of *Meats*; for example, to *Old Cheeſe*, or the like, when they happen to *taſte* of the ſame unawares, certainly contract a great loathing, and immediately, if poſſibly, vomit it up; but if they cannot, preſently fall *ſick*, or find themſelves very much indiſpoſed.

The Reaſon is no other than that the ſaid *Meats*, either by their *Odor* or *Vapor* inflict damage upon thoſe *Fibrels* or *pores* of the *Nerves*: For while they ill affect the *Nerves* inſerted into the *Ventricle*, they firſt cauſe a tremour of the *Lips* or *Nauſeation*; and if the ſaid Vellication of the *Nerves* continue, there will at length follow a *Vomiting*, which Nauſeation ever precedes; nor is the ſaid *Nauſea* any thing elſe than the *tremulous Motion* of the innermoſt *Membran* inveſting the *Mouth*, which proceeds even from the *vellication* of the *Ventricle*, as to which *Tunicles*, that of the *Mouth* is continuous.

IX. *Why upon defect of Taſte, defect of Smell ſhould follow.*

It may alſo be otherwiſe ſaid, that the privation of *Taſte* induces the failure of another *Senſe*, viz. *Smell*; by reaſon that both *Senſories* being planted near each other, are apt to be both together overwhelmed and glutted by the ſame *ſerous matter* ſqueeſed out of the *Blood*: In as much as the *tubulated Membrans* of the *Noſtrils*, and the ſtructure of the *Tongue* it ſelf conſiſt of a very rare, and as it were ſpongious compoſure: Wherefore the *pores* of either *Organ*, and the paſſages from the *Serous* floating *matter* are apt to be overflowed, and the *ſenſile Fibres* in both at the ſame time to be obſtructed; to which may be added, that whereas the *Noſtrils* and *Tongue* ought to be ſupplied with a continual *moiſture*; both of them as they moſt grievouſly, and more than other parts, undergo a deflux of ſuperabundant *Serum*, ſo both are equally obnoxious to the ſame miſchief upon any ſlight cauſe.

X. *Why ſick Perſons have an averſion to Meats that are ſweet.*

Sick Perſons, and thoſe that are of a *Craſie Body*, reject all ſweet *things*, and are only delighted with what is *acid* and *ſharp*.

The Reaſon why theſe *ſickly people* have ſuch an averſion to all *Meats* that are *ſweet*, is becauſe of the vitiated *Blood*, and the malignant quality of the *Morbifick Humour*, which being for the moſt part *Choler*, breaks into the *Tongue*, as being a very tender place, and cauſes innumerable obſtructions, hindring a juſt perception of the *Meats* that are preſented. Hence it is that *ſharp Meats* pleaſe the *Sick*, in regard the *Tongue* is covered with a certain *Uliginous tegument*, ſo that ſweet things cannot enter and paſs through it; whereas *Acids* affect in another manner, as conſiſting of long and inflexible parts. Nor is it for any other cauſe that *Beaſts* covet *Salt*, and are very much taken with the eating thereof, becauſe their *Tongue* is ſcabrous and rough, and overlaid with a certain Cruſt.

XI. *Sweet Meats hinder others from being reliſh'd.*

Who ever hath a reliſh of *ſweet things*, hath not a right reliſh of other *Meats* of a more accurate *taſte*.

Becauſe all Eſculent or Eatable Things are no otherwiſe *taſted*, but ſo far as the *Tongue* induces and inſinuates within the *pores* certain *Savoury Corpuſcles* reduced and made ſmall by *manducation* or *Chewing*. But whereas *ſweet things* are *viſcous* or *clammy*, and for the moſt part obſtruct the paſſages of the *Tongue*, they hinder the ſupervenient *ſavoury particles* from being carried into, and affecting the *Senſorium*. Wherefore the better to reſtore again the faculty of *Taſting*, we uſe to feed upon *ſharp* or *ſalt things*, to the end that they may looſen the paſſages of the *Tongue*, and wear away, and take off the inherent Viſcoſities.

XII. *How it is that Spittle is excited at the ſight of things grateful to the Palate.*

Spittle at the ſight of things grateful, and with which we are chiefly delighted, increaſes and fills the *Mouth*.

This happens by reaſon thoſe ſorts of *Meat*, which before are apprehended to be grateful to us, now again excite an *Appetite* in the *Soul* to receive them: Whence it comes to paſs, that the *Soul* being intent upon this alone, ſends more copious *Spirits* into the *Glandules* of the *Mouth*, ſo that they being ſo much the more compreſſed, the *Spittle* at the ſight of thoſe grateful appearances is ſqueeſed out in greater abundance.

CHAP. III.

Of the Senſe of Smelling.

I. *Man is the dulleſt of all Animals in the ſenſe of Smelling.*

OF all *Animals*, *Man* is thought to be that of the groſſeſt *Smell*, and who the moſt ſlowly takes in the Emanations flowing from *Bodies*.

The Reaſon is fetch'd from the Conſtitution of the *Brain* it ſelf, which being ſpongy, and abounding with much moiſture, blunts the edge of *ſmell*, and is the leſs affected by the ſaid Emanations. Hence thoſe that are troubled with a *Catarrh* or exceſſive deflux of *Humour*, many times have no ſmell, in regard the *pituitous Humour* blocks up the *Noſtrils* and the *Cribriformous* or *Sive-formed Bone*, to which the *Emanations* flowing, clot together, and are in a manner choak'd up: So likewiſe little or no *ſmell* is perceived under *water*, in regard the *moiſture* takes in the exhaled *Corpuſcles*, and obſtructs their diffuſion.

II. *They who have large Noſtrils ſmell beſt.*

They who have broad and open *Noſtrils*, and in whom the ſpongy paſſages of the ſaid *Bone* are from their Birth dilated, admit more eaſily and ſtrongly all *Odours* or *Smells*.

The Reaſon is, becauſe a greater abundance of *Emanations* is conveyed through thoſe Cavities to the *Brain*, which being gathered therein, and with mutual application aiming at the *Nerves* of the *Brain*, impreſs the greater affection. In a manner not much different from that whereby the *Air* inſpired through a broad and well purged *Ear*, enters more copiouſly the *Auditory Paſſage*, or whereby the *ſmoak* aſcends more eaſily through a wide *Chimney* than through a narrower.

III. *The Ox, Goat, and the like, excel other Creatures in ſmell.*

Hence in diſſections, we ſee in a *Goat*, *Ox*, *Sheep*, and other ſuch like *Animals*, that feed upon *Graſs* and *Herbs*, that the *Mammillary Proceſſes* are larger than in *Carnivorous* or *Fleſh-eating Animals*, becauſe they have more need of an exquiſite *Organ* of *Smell* to diſtinguiſh divers ſorts of *Herbs*, and to ſelect the more agreeable from the more noxious. For the ſame reaſon *Brute Animals* are indued with far larger *Olfactory Nerves* than *Man*, by reaſon that they diſcern their *food* by no other guide than *ſmell* alone; whereas *Man*, as one indued with *Reaſon*, knows many things by *Reaſon* and diſcourſe, and is led not ſo much by *ſmell* as by *ſeeing* and *taſting*, to the choice of his *Diet*.

IV. *Thoſe things which are grateful in ſmell to one, are very ungrateful to another.*

Thoſe things which are grateful in *ſmell* to ſome, are to others ungrateful.

The Reaſon lies in the diverſity of the *pores* in the *Olfactory Nerves* of this or that *Perſon*; ſo ſome are highly delighted with the *ſmell* of *Roſes*, while others reject them, in regard the *Volatile Particles* exhaling from *Roſes*, have ſuch a *Figure* that they can eaſily, and without any trouble paſs through the *pores* of ſome, but not without great difficulty and violence the *pores* of others; whence in theſe there ariſes a notable *averſion* of the *roſie ſmell*, in the others a wonderful delight therein. So *Men* without any diſguſt or trouble accept the *ſmell* of *Musk* or *Civet*, which at the ſame time to *Women* generally is odious and pernicious. Nay it cauſes in them *Hyſterick Paſſions*, whereof there can be no other reaſon but this, *viz.* that the *Volatile Particles* of the *Civet* or *Musk* cannot ſo eaſily and freely paſs the *pores* of a *Womans* Body as of a *Mans*, whence *Women* are moſt refreſh'd by the *odour* of the moſt ill-ſcented things, as *Aſſa-fætida*, and ſuch like *ſmells*, which *Men* can hardly indure.

V. *A Man that ſtinks is not ſenſible of his own ſtink.*

A *Man* that *ſtinks*, as they ſay, above ground, is not ſenſible of the ill-ſcented *Vapour* proceeding from him.

The Reaſon is, becauſe the *Organ* of *ſmelling* is ſo diſpoſed, that the inbreathed *ſmell* cannot be perceived but according as it falls upon adverſe *Fibres*; for there are in the *Noſtrils* certain *Valvules*, or little *Caverns*, whoſe *Mouth* towards the extremity of the *Noſe* is moſt open, and conſequently the *ſenſe* of *ſmelling* is only effected, when the *Breath* emitted from without arrives at the *Noſtrils*, and falls upon the adverſe *Fibres*: But when the foreſaid *Vavules* lie not open to the exſpirated *Breath* (that is to ſay, becauſe it falls not upon the adverſe *Fibres*) it comes to paſs that the *Organ* of *ſmell* is not touch'd, and conſequently no affection follows.

VI. *Continual Odour or Perfume ceaſeth to be ſmelt.*

Thoſe that long hold any *perfumed* thing to the *Noſe*, or live for any conſiderable time in a place full of *perfumes*, are at laſt ſenſible of no *Odour* at all.

This happens becauſe the *Emanations* or *Breathings* from *Bodies* perpetually, exhale forth, and are ſucceſſively conveyed through the *Air* to the *Noſtrils*, which when they arrive to, they do not immediately return back, but ſtick there ſome time, and ſo fill the *Appendices* or *Suburbs*, if I may ſo call them, of the *Brain*, that thoſe which follow after cannot penetrate them and make a freſh aſſault upon the *Senſorium*. This appears plain by thoſe that lay among their Cloaths *Civet* or *Musk Bags*, or *powder* their Hair with *Jeſſamin* or other *ſweet Powders*. Foraſmuch as after ſome time, they ceaſe to have any *Odour* of them, and

as if they were no longer reſpiring, are not in the leaſt affected with any *Scent* of theſe *expirations*: So that thoſe who love to *ſmell* to *Flowers*, or to enjoy the *Flagrancy* of any *place*, hold them by turns to their Noſe, and go and come ſeveral times to the place, to the end that the *particles* of *Flowers* or *Spices* may have time allowed them to depart from the *Organ* of *ſmelling*, and way be made for thoſe that come after.

VII. *How it comes to paſs that a Woman with Child miſcarries upon an ill ſcent.*

Sometimes it happens that a *Woman* with *Child* miſcarries upon an ill *ſmell*. I knew one who *ſmelling* the *Snuff* of a *Candle* blown out, fell thereupon in *Labour*, and brought forth an *abortive Child*, when near her time, and that not without great danger of her *Life*.

The Reaſon is, becauſe ill *Odours* grate and perplex as they paſs by, and ſo compreſs the *Organ* of *ſmelling*, that ſuch a ſort of *motion* being tranſmitted to the *Brain*, affects alſo the *Fibres* of the *Womb* which are connected with the *Fibres* of the *Birth*, and induces ſuch a diſpoſition, that the *Birth* forcing the *Umbilicar Veſſels*, breaks forth, and makes its paſſage out. On the contrary a grateful *Odour* refreſhes and comforts the Gravid Perſon, and renews her ſtrength, which ſuffers from the grievous and *fætid Vapours* wherewith ſhe is chiefly at that time infected, and therefore muſt needs be relieved by a *ſweet Odour*, as it were by a tenifying or emulgent draught, unleſs by chance the *Womb* labours with an overcorrupt *Humour*, and ſwells with Crudities.

VIII. *Smells are better perceived in Summer than in Winter.*

Smells are leſs ſcented in *Winter* than in *Summer*, and hence it is that *Hounds* follow the Game better in *Summer* than in the *Winter*.

Of this there can be no other reaſon than that the *Heat* which prevails in *Summer* dilates or widens the *pores* of all *Bodies*, which cauſes the *Vapours* the more eaſily to be diffuſed and ſpread through the ambient *Air*; whereas the cold by condenſation compreſſes the *pores* and hinders the *particles* of *Bodies* from being reſolv'd, and turn'd into *Vapour*; almoſt in the ſame manner as *Smoak*, which being excited by the *heat* of the *Fire*, is extended; but being invironed by *Froſt*, is contracted, and aſcends in ſlender *Columns* through the *Frigid Air*. Altho' it may alſo be ſaid that *Summer* is more apt and diſpoſed for the receiving of *Odours* than *Winter*, becauſe in *Winter* the *pores* of the *Body* are contracted, and leſs of *Vapour* is educed out of them; whereas in *Summer* all *Odours* are too much diſſipated by reaſon of the *heat* of the *Air*, and by the over-abundance of them, the *Organ* of *ſmelling* is diſturbed and diſordered.

IX. *Why Flat-Nos'd People for the moſt part ſend forth a ſtinking Breath.*

Thoſe who have *flat Noſes* ſend forth for the moſt part a very unſavoury *Breath*, whence proceed the many *ſcoffs* of *Poets* upon *Flat-Noſed People*, in which their *ſtinking Breath* is brought upon the Stage.

The Reaſon is, becauſe the *pores* through which the Humour flowing from the *Brain* to the *Noſtrils* paſſes, are obſtructed, or at leaſt are too narrow for it to run freely through them, ſo that by gathering and clodding there, it corrupts and putrifies. To which alſo may be added, that *Flat-Noſed Perſons* have for the moſt part vitiated *Lungs*, in regard that ſince the *Air* cannot paſs through ſo ſhort a paſſage or winding of the *Noſtrils*, ſo as to be well purged, the *Brain* and *Lungs* muſt needs be infected, and thereby cauſe a *ſtinking Breath*.

Thoſe who excel in *Wit*, are dull of *ſmell*, and ſometimes totally loſe that faculty.

X. *The moſt ingenious Perſons are the moſt dull of ſmell.*

The Reaſon is, becauſe thoſe are moſt *Ingenious*, whoſe *Brains* are beſt purged, that is, exonerated of all their ſuperfluous and excrementitious pituitous *humour*, from which the *Brain* being freed, is rendred the more prompt to execute thoſe *works* which depend upon the faculty of *Wit*. But they who have a deflux of *Flegm* or *Spittle* diſtilling down to the *Noſtrils*, muſt certainly of neceſſity become yet more dull of *ſcent*, in regard the *Flegm* obſtructs the *Noſtrils*, drives away the ſupervening *Odours*, and blunts their *Edge*.

CHAP. IV.

Of Hearing.

I. *We hear better by Night than by Day.*

WE are quicker of *Hearing* by *Night* than by *Day*.

The Reaſon is, becauſe in the *Night* the *Air* is ſtill and quiet, and not troubled with any loud *noiſes* or *ſounds*, which in the *Day* hinder us from hearing anothers *Voice* at any diſtance, in regard it preſently meets with various undulations of *Air* raiſed from external *ſounds*, into which immediately it transfers its *motion*, ſo that the *Voice* becomes as it were ſtifled in the *Air*.

II. *How Human Speech comes to be ſo various.*

Speech among *Men* is various, by reaſon that ſome *Men* in *ſpeaking* utter a great and manly *ſound*, others an indifferent, and others a ſhrill and effeminate voice.

The Reaſon is, becauſe in ſome the *Aſpera Arteria* is more ample or large, and ſo puts forth a grave or big *ſound*; but they whoſe *Aſpera Arteria* is of a mean or middle ſize, ſend out a *Voice* or *Tone* ſomewhat ſweeter, and as it were mixt of a grave and ſhrill *Tone* together: Laſtly, they who have it narrow and ſtreight, utter a *Tone* yet more ſhrill and alſo ſoft, ſuch as is for the moſt part that of *Women*.

III. *How it is that upon the Mutilation of the Ears they receive Sounds confuſedly.*

Thoſe that have their *Ears* cut off, relate that they confuſedly take in all *ſounds*; ſo they ſeem to hear upon all occaſions ſome inarticulate *ſound* or other, as the chirping of a *Graſhopper*, the murmer of a *flowing Stream*, or the like.

The Reaſon is, becauſe the exteriour *Ears* are hollowed and inlarged, ſo that the moved *Air* by paſſing through the *turnings* and *windings*, is gathered and made intenſe. For the *Air* enters ſo much the more copiouſly into the *Auditory Paſſage*, as coming from an ampler *ſpace*, it falls into the ſtreights. So that *Deaf People* oft-times ſupply the defect of that *Senſe* by holding their *Hand* hollowed, or a *Horn* to their *Ear*; for as the *ſound* is inlarged in winding Cavities, and enters the *Ears* with the greater force; ſo *Animals* that have moveable *Ears*, at the *hearing* of any *noiſe*, prick them up that the *ſound* may enter in more copious and direct: Therefore the *Ears* being cut off, the *ſound* falls directly into the *Auditory Paſſage*, which cauſes the failure of that determination which ought to be, and which happens but at the *inſtant* of the ſaid *Illapſe*. And thereupon the *ſound* comes to them no other way, than if it proceeded from various parts, as it happens in the inſtances before-mentioned.

A *Tune*

IV. *A Tune plaid on a Pipe is more charming than that plaid on a Harp.*

A *Tune* plaid on the *Pipe* is more ſweet and charms the *Organ* of the *Ear*, more than if plaid on a *Harp*.

The Reaſon is, becauſe the *ſound* of a *Pipe* is more continuous and leſs disjointed, than that of a *Harp*. For in regard we are delighted with modulation, and take greater pleaſure to hear proportionate *Movements*, we are moſt taken with thoſe which keep a certain *Tenour*, and ſmite the *Soul* with repeated *ſtrokes*. To this may be added, that the *ſound* of a *Pipe* is as the *Voice* performed with reſpiration, and conſequently the *Notes* are the more eaſily mixt one with another. For the *Harp* produces a certain *aſperity*, and howſoever ſtruck creates harſhneſs to the *Ear*.

V. *Perſons ſmitten by a Tarantula, are cured by Muſick.*

Thoſe that are ſmitten with the *ſting* of a *Tarantula*, are ſaid to be cured by *Muſick*; in ſo much that let a *Muſitian* be brought to the Perſon ſo ſmitten, and let him ſing by him to his *Lute* or *Harp*, and the Patient ſhall riſe from his Couch as he were wakened out of his *ſleep*, and ſhall ſo exerciſe his *Feet* for ſome *hours* by his ſtrenuous *Dancing*, that all the *poiſon* ſhall effectually evaporate by *ſweat* out of his *Body*.

The Reaſon of this ſo wonderful effect, is to be attributed to the *motion* cauſed by the *Muſical Inſtrument*, by which the Drum of the *Ear*, and afterwards the *Brain* being ſmitten, by their help, alſo the *Arteries*, *Nerves* and *Muſcles* are excited; ſo that upon the excellent and well-followed performance on the *Harp*, the *Patient* to free himſelf from the *Tarantula's poiſonous ſtroke*, falls a *dancing* with all his might; and by this means not only hinders the force of the *Venom* from ſpreading farther, but alſo by the continual agitation of his *Body* expels and breaths it out by *ſweat*, in regard the *playing* on the *Harp* ſo far ſtirs up a *motion* in the *Nerves*, as to diſſipate the force of the *Venom* which poſſeſſes the *Arteries*.

VI. *Why ſome ſo ſtung are not cured by Dancing.*

But if it happens at any time that ſome are not cured by *dancing*, (for it hath been found by experience, that *perſons ſtung* by the *Tarantula* have danc'd thirty or forty years without cure.) It is becauſe the *Sting* poſſeſſing the *Arteries*, *Nerves* and the *Spirits*, contained in them, hath been more tenacious and viſcous, than to be capable of exhaling and being rarefied.

VII. *Deaf Perſons have been brought to hear better by a great Noiſe made about them.*

It hath been known that *perſons* of vitiated *Ears*, and almoſt deprived of the ſenſe of *Hearing*, have by a very loud ſound (for example of *Drums* and *Trumpets*) been brought to that paſs as to receive the words of people *ſpeaking* to them, and to give anſwers to their *Interrogations*.

This happens from the *Drum* plac'd in the *receſs* of the *Ear*, which being looſened, admits of no affection from the ſoft impulſe of *ſound*, but upon the din of a very great *noiſe*, acquires its due tenſion; ſo as commodiouſly enough to perform its *office*; and thus the *Cauſe* is made plain why a certain *Deaf Man* of *Orleance* living near a great *Steeple* of *Bells* could eaſily hear the *words* of thoſe that ſtood talking with him, ſo long as the ſeveral *Bells* were ringing; but upon the ceaſing of that *noiſe*, he fell back to his wonted deafneſs, and could no longer hold diſcourſe with thoſe about him. So a certain young *Nobleman* born near *Oxford*, plainly heard the words of thoſe that were near him while he paſſed through *London-ſtreets* in a *Chair*, or any loud *Noiſe* was made about him, by reaſon that upon a notable concuſſion of the *Air*, the *tympanum* was reduc'd to its due tenſion, and acquir'd its turgeſcence.

VIII. *How it comes to paſs that by keeping in the Breath, we hear the more plainly.*

When the *Breath* is kept in, we receive ſo much the more eaſily and plainly the approaching *ſound*; whence in *hearkning* earneſtly to any *ſounds* which come from afar off, we commonly keep our *Breath*.

The Reaſon is, becauſe all expiration is a *motion ad extra*, as my Lord *Verulam* calls it, rather repelling than attracting the *ſound*; ſo upon whatſoever thing we are moſt induſtriouſly bent, and labour with moſt vehement intenſion, we ſtop and keep in our *Breath*; for a catching with a difficulty at any *flying ſound* is but a certain ſort of laborious work.

IX. *We hear not all Sounds with like ſuddenneſs.*

It happens frequently, eſpecially in a confuſed multitude of *ſounds* and *words*, that we preſently *hear* the *ſpeeches* of ſome certain *Perſon*; but thoſe of another *Man*, tho' *ſpeaking* at the ſame time, we are not ſenſible of, till ſome time after.

The Reaſon is, becauſe the *ſound* or *voice* of one *Man* taken in with that of another, is not altogether at the ſame moment of time, conveyed to the common *ſenſorium*, but one after another enters the *Ear*. Whence it is probable in ſuch a caſe, that the firſt *ſound*, one winding of the *Ear* alone being gained, is thereupon ſooner tranſmitted from the firſt Branch of the *Auditory Nerve* to the common *Organ*; but the later as it were ſenſible, becauſe it cannot be transferred together at the ſame time in the ſame *Nerve*, making therefore another circuit through the ſecond *winding*, it is at length removed from the ſecond Branch of the *Auditory Nerve*, and conſequently ſucceeding the former, is later taken in.

X. *Words pronounced without, are better heard from within a Chamber, than on the contrary.*

Let any one be plac'd in a *Chamber*, and he ſhall more clearly and diſtinctly *hear* the *words* which are delivered from without, than were he plac'd without, he could hear them, being utter'd in the *Chamber*.

This comes to paſs, becauſe the *ſound* diffus'd through the *Air*, is reflected by interpoſed *Bodies*, as ſufficiently appears from an *Eccho*; for in regard there are many *ſolid Bodies* within the *Chamber*, as *Walls*, *Planks*, *Tables*, &c. which drive back the emitted words, it happens that the *ſound* becomes the ſtronger, and more forcibly ſmites the *Ear*, than in the free *Air*, where thoſe obſtacles are not to be met with, from whence *ſounds* reſult. Hence it is that he who *ſpeaks* from any high place is better *heard* by him who is beneath, than on the contrary he that *ſpeaks* from a low *place* is heard by one above; becauſe more *Bodies* occur from which the *voice* may be reflected, whilſt it tends downwards, than whilſt it flies up, and wanders through the *Air*.

XI. *Why the ſound of a Bell is not always heard from the place where it is.*

The *ſound* of a *Bell* happens ſometimes to be heard in ſuch a manner, that it ſeems to proceed not from the place where it is, or whence it really proceeded, but from the oppoſite part.

This fallacy proceeds from the reverberation of *ſound*, which coming laſt to the *Ear*, ſeems therefore to proceed from that place from whence it was reflected: For as by the reflection of *Rays*, a thing appears not where it is, but in that place whence the *Rays* are laſt derived: So a *Bell* or any other

other *ſonorous Body* is judged to be in that place where the *ſound* came laſt to the *Ears*: For a *ſound* reflected by an *oblique Line*, arrives at the oppoſite part. In like manner a *Bell* being rung from the *Northward*, if the *Chamber Window* where we are, open to the *South*, we ſeem to hear the *ſound* from the *Southward*: So if a *Beggar*, as we are ſitting in a *Chair* or *Sedan*, make his *Speech* on that ſide the *Chair* where the *Glaſs Window* is up, he will ſeem to be on the other ſide where the *Window* is open or let down.

XII. *Whence it is that a kind of murmuring ſound is heard upon ſtopping the Ears.*

If any one ſtop both *Ears*, or either of them very well, he will nevertheleſs *hear* a certain tremulous and murmuring *ſound*.

The Reaſon is, becauſe of the agitation of the *Air* included in the *Ears*: For in regard there is a continual efflux of very much *Breath* from the *Ears*, if upon a ſtoppage applied, the ſaid efflux be barricadoed or ſhut up, the *Air* pent in within the Cavities of the *Ears*, and impatient of its narrow confinement, drives and forces into the *tympanum*, from which vehemence of agitation a certain *murmuring noiſe* muſt needs ariſe, and affect the *Ears* in ſuch ſort, as if it proceeded from ſome ſonorous object. Which that it is ſo, is from hence ſufficiently evident, namely that a vehement *external noiſe* being raiſed, that *internal humming ſound* is ſuppreſſed, and that indeed for no other reaſon but becauſe a new agitation inwardly induc'd, directs the tumultuating *Air*, and forms it into *Rays*.

XIII. *How it is that two unequal ſounds are equally quick.*

We oftentimes equally ſoon, at one and the ſame diſtance hear two unequal *ſounds*.

This ſo happens, for that the *agitation* of the *Air* which makes the *noiſe*, hath always an equal ſwiftneſs at the ſame diſtance, tho' it is made with a greater or leſſer effort, ſo that the *noiſe* of a *ſonorous Body* extends it ſelf with the ſame ſwiftneſs at one and the ſame diſtance, altho' the *Body* be ſmitten with an unequal force: For a greater force may indeed contribute to the making of a greater *ſound*, but not in the leaſt to the making it to be of a farther extent.

XIV. *Why ſound cannot be heard under water.*

That famous *Diver* in *France*, wrapt up in his own *Machine*, which takes not away *Hearing* from any one ſo long as he continues above *water*, affirms that when he was about ten *fathom* under *water* in the *Ocean*, not far from *Diep*, he heard not the leaſt report of thoſe *Guns* which the *Ship* was obliged to diſcharge as it *ſailed* out of the *Port*.

The Reaſon is, becauſe *ſound* cannot be procreated, except in a moveable Object; ſo that if that *Medium* through which it is to be tranſmitted, cannot conceive any *tremour*, or reſiſt the *tremour* of other *Bodies*, it can produce no *ſound*. Wherefore ſince the bulk of the *Water* is ſo great that it cannot be agitated by the moved *Air*, and reſiſts its *tremours*: No wonder if the *noiſe* produced above the *waters* reach not ſo far as the bottom; for as we find by experience, that a *Stone* falling into a *River* from a high place, makes no noiſe when it come to the bottom, tho' it hit againſt other *Stones*: So an exterior *ſound* cannot ſo penetrate the extraordinary heighth of the *Waters* as to be received by it; and ſo they who *ſwim* upon their *Backs*, ſcarce hear any thing ſo long as they have their *Ears* immerſt, and lie beneath the ſurface of the *Water*.

XV. *Fiſhes in the water hear not.*

Whence it is evidently made out, that all *Fiſhes* are *deaf*, or void of *hearing*, except thoſe of grand bulk, as the *Whale*, *Dolphin*, the *Phocæ* or *Sea-Calf*, which raiſing their *Heads* above *Water* both take in *ſounds*, and utter a voice from their Mouth.

The Reaſon why other *Fiſhes* ſeem to be *deaf*, or void of *hearing*, is becauſe they are wholly *mute*; for there ſeems to be that correſpondence between the *Voice* and the *Ear*, that thoſe very *Animals* which want *Voice*, the ſame alſo are deſtitute of *Hearing*, by which at the ſame time the *word* and the *thing* ſignified thereby are apprehended. Now if it be objected that *Fiſhes* decline the *noiſe* of the *Oars*, and that the *Fiſhermen* commonly beware of the tottering of their *Boat*, or of making a *noiſe* with their *Nets*, when they beſet the *Shoal*: I anſwer, that all this is, leſt upon the motion of the *Water* ſtirred up by the force of the *Oar*, or the overmuch tottering of the *Veſſel*, the *Fiſh* ſhould apprehend the ſaid *motion*, either by *touch* or *ſight*. For we may obſerve in a *Fiſh-pond*, that the *Pikes* and other ſorts of *Fiſh* ſwimming therein, are terrified by no ſort of *noiſe*, *murmur* or *ſound*, but upon the leaſt unuſual agitation or motion made in the *Water*, they immediately fly and ſhift their places, and if being called to Meat they ſometimes come; this comes to paſs, either becauſe they are mov'd at the *ſight* of the *Perſon* calling, or becauſe the *Water* is moved by the lowdneſs of the *Voice*.

CHAP. V.

Of Sight.

I. *Why the Eyes move both together.*

AS we go about to look upon any *thing*, both *Eyes* tend to the beholding of the ſaid *Object* with one and the ſame *motion*, while in the mean time each of them hath its *Muſcles* diſtinct, and proper to its ſelf.

The Reaſon hereof proceeds from the *Mind*, which when it ſets its ſelf intently to behold any thing, it is not to be imagined that one *Eye* is bent upon the beholding of that thing, and that the other is imployed upon another *Object*; for by that means there would be a *confuſion* of the *Rays*, and of the perception in the common *ſenſorium*. But both *Eyes* muſt neceſſarily be directed at the ſame time, to the ſame *Object*. And to this end the *Spirits* are always diſpoſed to the ſervice of thoſe *Muſcles* which are capable of converting both *Eyes* to this one *place*; and not to thoſe which ſerve to draw either *Eye* one way, and another another; for the *Mind* is always bent upon ſeeing one *thing*; and tho' it often deſigns to have the *ſight* of many *things*, yet to take the better view of each, it takes it in a certain order, and views them one after another; which may quickly be done, if the things to be ſeen are near enough and big enough to be eaſily and ſoon beheld.

II. *How a Flea and a Horſe may both ſeem to be of the ſame magnitude.*

Who ever looks upon a *Flea* near at *hand*, and extends his *ſight* to a *Horſe* or other *Animal* of like magnitude at a very great diſtance, they will appear equal, and offer themſelves to view under the ſame magnitude.

This is evident from *Opticks*, by which it is thus made out, namely that the faculty of *ſeeing*, or rather the *Soul* reſiding in the *Brain*, apprehends *Objects* to be greater or leſſer, according

as they were represented to the *sight* under a greater or lesser *angle*. So that when as a *Flea* being seen very near at hand, and a *Horse* at a remote distance, seem both under the same *angle*, they are look'd upon by the *Soul* as equal: For it is evident that an *Object* is therefore apprehended greater, because it impresses a greater affection upon the *Retin Tunicle* or *Optick Nerve*, and lesser so far as the lesser proportion of the *Organ* is affected. Hence it is that the farther a *thing* recedes from us, so much the *lesser* it appears; and by how much the nearer it approaches us, so much the *bigger* it shews, in regard the *Object*, by how much the farther it is removed from us, appears with so much the acuter and smaller *angle*, and impresses the lesser affection. The Reason of all this is, because while the *Object* recedes and withdraws it self by little and little from the *Eyes*, it is not only diminished as to its *circumference*, but as to all the *parts* which are turned towards the *Eye*, because tho' it always remits its *Rays* in like manner from each *point*, yet most of them according to the rate of their *recess* and *elongation*, slip beside the *Eye*, and are elsewhere disposed.

III. *Convex things appear afar off as if they were plain.*

In like manner those things which are seen afar off, tho' they are square and angular, yet they seem round in regard the distance of the *angles* cuts off the excursions and asperities; so we receive *Convexes* as they were plain, because all inequality of *parts*, by reason of so great an interval totally disappears. Hence the *Sun* and all the *Stars* appear to our *sight* not *convex* but *plain*; for tho' their middle parts are nearer to our *Eyes* than the extreme, yet that difference is but very small, if compared with so great a distance.

IV. *Why an appearance in a Looking Glass seems to be beyond the Person looking.*

An *Image* of any one beheld in a *Looking Glass*, appears as much beyond it, as the *Spectator* Stands on this side it.

The Reason is, because the *Spectator* beholds his *Face* in the *Glass*, not as fix'd therein, but as sliding from him; and consequently the matter is to be considered, as if the *Spectator* were from the *Looking Glass* behind himself; whence it comes to pass, that the same *distance* is repeatedly apprehended by a reciprocal comparison: And because this *reflexion* causeth no necessity of the *Spectators* being transferred into the place of the *Looking Glass*, or altering his situation to be converted again into himself, it comes to pass, that after the *Axis* which is directed from the *Spectator* to the *Glass*, he immediately receives an *Axis* which tends from the *Glass* to the *Spectator*; and because of the unalterableness of the *situation*, hath both for the same continued *Right Line*, whose middle is from the *Spectator* to the *Glass*, the other half from the *Glass* to the *Image* beyond the *Glass*, where the *Spectator* represents from whence he comes.

V. *How it is that an Object may distinctly be discerned through a small hole.*

An *Object* which appears too confused, as being too near the *sight*, may distinctly enough be seen, if any one behold it through a little *hole* made with a *Pin* or *Needle* in a *Card* or piece of *Writing Paper*.

The Reason is, because the *Eye* then receiving a lesser quantity of *Rays* from every point of the *Object*, every one of them describes its *Image* alone in a very narrow space; and so they which proceed from the two *Neighbouring Points*, scarce make any confusion in their *Actings*.

VI. *Those that dive into the water, see Objects only confusedly.*

Urinators or *Divers* see *Objects* confusedly in the bottom of the *Waters*, except they make use of very *Convex Glasses*.

The *Reason* is, because the *Rays* of *Light* are not sensibly broken when they pass from the *water* into the *aqueous* or *watry humour* of the *Eye*; and so those that proceed from the same point are not again compelled by falling into the *Retin Tunicle*, which may be gained by the use of very *Convex Glasses*.

VII. *How low Objects come to seem high, and high, low.*

Things presented to the *sight*, by how much the farther they are distant, so much the higher they appear, and on the contrary high things so much the lower.

The Reason is, because things near at hand emit those Rays which smite the superiour parts of the *Eye*, or *Retin Tunicle*; whereas things remote send forth those *Rays* which arrive at the inferiour region of the *Eye*; and when the *Objects* in the *Retin Tunicle* are form'd with an inverted *situation*, those must needs seem more depress and low, these more sublime. On the contrary it happens, when we convert the *sight* of the *Eye* to things plac'd on high; for then those things which are at a greater distance seem *lower*, in so much that the utmost bound of *Heaven* appears as it were conterminous to the *Horizon:* Forasmuch as that part of the *Heaven* which is our *Vertical point*, affects the lowest part of the *Eye*, and the other parts emit *Rays*, so much the more *sublime* by how much the more remote they are; hence that appears the supream of all, and the rest are so much the more *sublime*, by how much the nearer they approach to the *Vertex*; and so much the more depress and low, by how much the farther they receed from it.

VIII. *Objects ceasing to be seen when the Pupil is contracted.*

Objects sometimes by the contraction of the *Pupil* or *Apple* of the *Eye* are hidden to the *sight*, as if any one should direct his *sight* to some remarkable *Star*, for example, *Venus* or *Jove*, and by some Art should contract the *Pupil* of the *Eye*, the *Star* at first seen will by degrees disappear, and at length totally fly the *sight*.

The Reason of this is drawn from part of the said *Pupil*, which according to the rate of the said *coarctation* or *dilatation*, causes the *Object* to be seen, or to fly the *sight*: For since upon the contraction of the *Pupil* it receives fewer *Rays* under a smaller *angle*, it causes the *Object* to appear less, and consequently if they are so few as to be comprehended in an insensible *angle*, they will no way affect the *Retin Tunicle*, so far as is required to *Vision*; and as that affection is not perceived, so neither will the *Object* which ought to be perceived by the mediation thereof, be any farther deprehended. For it conduces to the rendring of that *affection* insensible, that in the contraction of the *Pupil*, the *Chrystallin Humour* be somewhat relaxt; whence it comes to pass, that the *bottom* of the *Retin Tunicle* goes back so little, and becomes more weak by the incidence of the *Elapsed Rays*; which two things are sufficient to make the *Object*, at the contraction of the *Pupil*, to disappear, and what was seen before, to become afterwards invisible.

Hence

IX. *How the Stars come to appear bigger by Night, and lesser by Day.*

Hence it is that the *Stars* appear lesser by *Day* than by *Night*, when our *Hemisphere* is overlaid with *darkness*, namely by reason of the *Pupil* in the *light*, and the expansion of it when it is *dark*. For it is certain, that the *Pupil*, when ever *light* takes place, is rendred more narrow, and consequently that fewer *Rays* from a *flame* of *Fire* enter the *Eyes*, and that a lesser portion of the *Retin Tunicle* is affected; but the *Air* being overspread with *darkness*, it plainly appears that the *Pupil* is dilated, and consequently that many more *Rays* arrive at the *Eye*, and that a greater portion of the *Retin Tunicle* being affected, a greater *species* also of the *Object* is produc'd therein. Hence also it comes to pass, that the magnitude of the *Stars* seems in the *Evening* to *increase*, and so in the *Morning* to *decrease*; by reason that the *Pupil* in the *Evening Season* is by little and little dilated, and in the *Morning* by little and little contracted, and by this means the *Retin Tunicle* is ever less and less affected. So the *flame* of a *Candle*, if by *Day* it be beheld a hundred paces off, it appears very small, but upon the coming on of the *Evening*, it began to grow bigger, till *Night* at length increased it to the appearance of a considerable *Torch*.

X. *How some Men discern Objects at a very great distance.*

It is reported of STRABO, that he was of so sharp and quick an *Eyesight*, that he could discern *Fleets* setting *Sail* from out of *Lilybæum*, a Port of the *Carthaginians*, at the distance of above a hundred *miles*: Moreover, LOPEZ, a *Spaniard* at *Gades*, is related to have been able to discern from the top of the Mountain *Calpe* on the *Europæan* side, to the opposite Shore of *Africa*, over the whole *Bay* between, which by the Testimony of *Cleonardus* in his *Epistle* to *Jacob Laboe*, is in a *Calm Sea* no less than three or four hours *sail*, and that so distinctly, that he could relate many things he saw there done.

This so wonderful a sharpness of *sight* depends mainly upon a double disposition of the *Persons* so indued, first from the docility of the *Chrystallin Humour*, and the easie use of the *Ciliary Processes*; namely, whilst according to the different incidence of *Rays* reflected from the Objects, the *Chrystallin Humour* is in such a manner adapted and disposed as an exact projection requires. 2*dly*, It is necessary that the *Capillaments* of the *Retin Tunicle* be so exquisitly disposed, as to receive the least affection. Because altho' those things which we behold with our *Eyes* cannot be discerned, but so far as in some sort they differ in *colour*, yet a distinct perception of *Colours* proceeds not only in this, that all the *Rays* proceeding from all points of *Bodies* meet in the bottom of the *Eye*, in so many other *Rays*, or thereabout; but also from the multitude of the *Capillaments* of the *Optick Nerve*, whose extremities are contain'd in that space which the *Image* in the bottom of the *Eye* possesses. Whence no doubt is to be made but STRABO and that *Spanish* LOPEZ injoyed so accurate a *contexture* of the *Retin Tunicle*, and had so docile a *Chrystallin Humour*, that they were able to contemplate Objects more distinctly than others, and have a prospect of them at so vast a *distance*.

From this very cause it happens, that some *Men*, like *Owls*, see even in the darkest *Night*, as it is related of the Emperour NERO and others, namely, that they have most slender and very moveable *Fibres*, of which their *Optick Nerves* are framed; so that that little Light which remains in the most obscure *Nights*, suffices to affect their *Fibres*, and to excite the sense of *seeing* in them.

XI. *How it is that some Men see by Night.*

If a *Stick* fired at the end be swiftly whirl'd about, there will appear to our *sight* the *Image* of a *fiery Circle*, tho' the *Stick* be not in all points of the *Circle*.

XII. *How a Body appears where it is not.*

The Reason hereof is, because the *Stick* makes an impression in those parts of the *Retin Tunicle* which are circularly disposed; so as that the foreparts being agitated by the celerity of the *motion*, still retain something of its *impression*, whilst it agitates the last parts. For this *motion* is not at one and the same individual time, but in divers successions of Moments, so swiftly performed, that the *Vibration* of *Fire* impress upon the *Eye*, remains in the first parts of the *Retin Tunicle*, when the *Stick* hath declined to the other parts of the *Circle*. When no wonder if the *Rays* entring the *Eye* by the *Pupil*, oft-times effect at once a sensation of *Greenness*, *Redness*, *Blackness*, *Whiteness*, and other *Colours*; because the *Rays* modified by divers *Colours*, in divers successions of Motions following each other with incredible swiftness, hit upon the *Retin Tunicle*, and leave a little while their *agitation*, till other *Rays* presently entring the *Pupil*, impart in their turn their *motion*, and there leave it some time with others.

XIII. *How it is that they who have a Cataract couch't, see obscurely.*

Those that have a *Cataract Couch'd*, discern but obscurely all visible Objects; whereupon that they may the more clearly and distinctly see them, they make use of *Convex Glasses*.

To make this the more clear and evident, we must observe, that a *Cataract* is not any *Skin* (as hath been long believed) growing between the *Chrystallin Humour* and the *Uveous Tunicle*, which may be taken off by a *Needle*, and drawn down to the inferiour part of the *Eye*, but that it is the *Chrystallin Humour* it self, which in tract of time grows flaccid and weak, and is separated from the *Ciliary processes*, as an *Acorn* when ripe, is easily separated from its *Cup*, forasmuch as it is removed with little or no trouble, and depress to the very bottom of the *Vitreous* or *Glassy Humour*, a small part, in the mean time, of the said *Vitreous Humour* succeeding in its place. The *Cataract* therefore being thus taken away, the *Chrystallin Humour* also must of necessity be taken away, or at least be rendred more plain, or less convex, whereby it comes to pass that the *Rays* proceeding from all points of the Object, are not sufficiently broken or made bending, so as to be united in the *Retin*, when they arrive there: Whence the *Vision* or act of *Sight* must needs be confused. To which infirmity the *Chrystallin Convexity* only gives relief, as causing the *Rays* which before were divergent to become convergent, and to enter the *Eye* with such a *disposition*.

XIV. *Divers Colours appear upon sight of the Sun.*

Upon *sight* of the *Sun*, or any other *Glaring Light*, we seem to behold various *Colours*.

The

The Reason is, because such is the nature of our *Mind*, as by virtue of the *motions* that occur in that part of the *Brain* whence the tender *Filaments* of the *Optick Nerves* proceed, to be capable of having a *Sense* of *Colour*; whereupon in regard the *Agitation* by which, after the *Eyes* shut, the *Capillaments* of the *Optick Nerve* still palpitate, and as it were tremble, is not strong enough to render the *Light* so bright, as that was from whence it came, it represents *Colours* less intense, and as it were dilute; but that these *Colours* are produc'd from motion, may from hence be easily concluded, namely that growing pale by little and little, they are changed, and passing mutually into each other, vanish by degrees.

XV. *How it comes that the top of a Mountain far distant seems contiguous to the Horizon.*

The top of a *Mountain* reaching far beyond the visible *Horizon*, appears to us as joined with it, together with the Hill it self, and the *Sun* when it *rises* or *sets* seems to adhere to, and be united with the said *Horizon*.

The Reason of this appearance is, because things appear at no distance from us, when the *Rays* cohere, and without the interposition of other *Bodies* apply to our *Eyes*; as it happens in the forementioned case: Forasmuch as tho' there is a vast distance between the *Sun* and the *Horizon*, and many *Bodies* are contain'd therein, yet because none of those *Rays* arrive at us, but only from the *Sun* and the *Horizon*, it happens that they seem among themselves contiguous and cohering. For the distance of the *Horizon* is no other ways known by us, than from the diversity of *Bodies* interpos'd between us and them; whence if those intermediate spaces should happen to be obstructed, and nothing of them could possibly be transmitted to us, we must needs judge those things which we *see* afar off, to be contiguous and separated by no interval. Wherefore GASSENDUS thinks that *Dogs* bark at the *Moon*, because they apprehend it to rise near the *House* top, and so to be very little more distant than the *House* it self, and not much bigger than that part of the *House* comprehended by it.

XVI. *Ditches from a low place appear joined together.*

So if we behold many *Ditches*, the *sides* of them plainly appear to us as not much distant from each other, because they are represented to us by *Rays* from the *Eye*, to which many also that slide from the bottom, mingling themselves, are carried upward; but if we behold those *Ditches Horizontally*, or from a low place, their sides seem to us to have no distance at all, because no *Rays* proceeding from the bottom, reach the *Eye*, and those which proceed from the sides, stick as they arrive.

XVII. *Why Drunken Men see double.*

Drunken Men see every Object double, which VIRGIL asserts also of *Mad Men*. 4 *Æneid.*

This proceeds from the dark and malignant *Vapours*, either flowing from the *Wine*, or stirred up by the malignity of the *Distemper*, which while they pervert the situation of the *Optick Nerves*, they make such a percussion of the *Brain* at the same time, as if the *Rays* exhaling from the Objects, proceeded from detorted *Eyes*: Whence those that by *Nature*, or any chance or accident, have their *Eyes* drawn awry, see all things double.

XVIII. *Why we see from the dark, things set in the light*

We find by *daily experience*, that standing in the *dark*, we plainly see things put in a lightsom place, but not on the contrary, from a *light* place things set in the dark.

The Reason is, because the *Rays* of *Light* may be directed to the *Eye*, being in a misty or dark place, that some of them may make their way into the said obscure place, if the passage be open enough, and the *Light* gliding through it into the *Pupil* of the *Beholder*, arrive as far as the *Retin Tunicle*. But he who is in the midst of the *Light*, cannot apprehend those things which are in an obscure place, because from thence no *Rays* proceed, which either directly or by reflection can touch the *Retin Tunicle*; unless by chance the *darkness* be some way or other intermingled, and remit some *Rays* of *Light*; for then nothing would hinder, but that a few *Rays* reflext from things would sensibly affect the *Eye*, and represent some sort of *Image* of *things*.

XIX. *The Hyperboreans have generally very weak Eyes.*

The *Hyperboreans* or *Inhabitants* of the most *Northern Countries*, have generally bad *Eyes*, and are *dim-sighted*.

The Reason is, because they are perpetually conversant in *Snow*, which above all things reflects back the *Light*, by reason whereof their *Eyes* must needs be strain'd, or because their *Retin Tunicle*, hardned by the *external brightness*, is less capable of expressing, or entertaining an affection necessary for *Sight*. When as we see that the *Chrystallin Humour* becomes congealed with *cold*, and attains to such a rigidity or stifness, that it can neither be bent, nor contracted, nor unfolded.

XX. *Bodies moved with a rapid swiftness are not perceived.*

A *Cannon Bullet*, or any *dark Body*, passing with incredible swiftness through a *whited Wall*, becomes altogether imperceptible.

The Reason is, because the *dark Body*, as likewise that so rapidly moved, making no impression upon the *Eyes*, so lightly, at that time, interrupts the reflection of the *Rays* of *Light* from the *Wall*, that the *Eye*, for that small interval of *time*, preserves the commotion which those *Rays* immediately before produc'd. The contrary whereof we find by experience in a *Firebrand* whirl'd round, in regard the *Brand* impresses its force upon the parts of the *Retin Tunicle* formed into a round, because then the rapidity of the *motion* causes the part first moved to keep yet a little while that impression which the *Brand* makes upon the last.

XXI. *Why Goggle-eyed Persons cannot see clearly at any great distance.*

Those that have prominent or *Goggle Eyes*, as the *Myopes* or *Purblind People*, see not Objects distinctly at any great distance.

The Reason is, because the *Rays* of *Light* driven and refracted upon the prominent *Eyes*, meet sooner than they can arrive at the bottom of the *Eye*; Forasmuch as they represent the *Image*, not in the *Retin Tunicle*, but on this side; namely in the *Vitreous Humour*. Wherefore *Goggle-eyed Persons* are wont to make use of *Prospective Glasses*, because by them the *Rays* are divided, and do not so soon concur and meet together.

XXII. *The Object is varied according as it is represented in divers Glasses.*

An Object in a *plain Glass* appears just as big as it is, but in a *Convex*, less; and in a *Concave*, greater.

The Reason is, because a *plain Glass* remits towards the *Eye* all the *Rays* from each direct point of the Object, and thereby every thing must needs be

be repreſented juſt as big as it is. Whereas the *Convex*, by reaſon of the obliquity of the incidence, diverſly diſperſes this way and that way a great part of the *Rays*; whence it is that few of them are directed into the *Senſorium*; and on the contrary, the *Concave* not only remits to the *Eye* the *Rays* which are reflected from the *plain*, but alſo very many more, which come from the little devexitated *regions* of *particles*, and thoſe of *points* alſo elſewhere obverted. Whence it comes to paſs, that the *Figure* is increas'd, and exceeds in magnitude the repreſented *Object*.

XXIII. *Why ſome Men ſee nothing, but at ſome certain diſtance.* Some *Men* perceive not Objects, except at ſome certain diſtance, in ſo much that either very near, or very far off, they ſee but confuſedly.

The Cauſe hereof is chiefly cuſtom, as when *Men* uſe themſelves to look at ſuch a *diſtance*; for the *Muſcles* which are diſpoſed to the immutation of *Figure*, are rendred as it were ſtupid, and unapt for their wonted *functions*; not otherwiſe than the reſt of the *Muſcles* of the *Body* become unuſeful for the motion of the *Members*, after they have ſtood long unmoved. To which may be added, that the *Membrans* which contain the three *Humours* of the *Eye*, may poſſibly have become ſo hard, as not to be ſo flexible as formerly.

XXIV. *How a Blindman ſaw a little, by compreſſing his Eye.* A certain *Young Man* being *blind*, while he preſt either *Eye* towards his *Noſe* with his *Finger*, could ſee a little, otherwiſe nothing at all.

Poſſibly this might be, becauſe by the ſaid compreſſing of the *Eye*, he inverted the convexity of the *Chryſtallin* or *Uveous Humour*; whence followed a change of the Projection, and conſequently another Affection. In like manner as when holding to our *Eyes* a *Leaf* of a Book *printed* in a very ſmall *Character*, we keep one *Eye* ſhut, and preſs the other down with two *Fingers*, we ſhall fancy the *Letters* to be increaſed, and become bigger.

XXV. *Why the whole Sun cannot be ſeen in an Optick Tube.* The whole *Diſcus* of the *Sun* cannot be ſeen by the help of an *Optick Tube*, tho' the whole *Image* be projected upon an oppoſite *ſheet* of *Paper*.

The Cauſe hereof is, by reaſon that the *Optick Tube*, in reſpect of its Cavity, divides the many *Rays*, and ſuffers them not to fall into the *Eye*; whereas all the *Rays* of the *Sun* fall upon the *Paper*, and form therein a far more large *Effigies* of the *Sun*.

XXVI. *Viſion is made much more diſtinct, by a hole made by a Needle in a Card or Paper.* An Object which appears confuſed, as being too near the *Eye*, may be ſeen diſtinctly enough at the ſame diſtance, by any one through a hole made with a *Needle* in a thin *Card* or *piece* of *Writing Paper*.

The Reaſon is, becauſe the *Eye*, then receiving a leſſer quantity of *Rays* from every point of the Object, each of them forms its *Image*, even in a very narrow ſpace; ſo that thoſe which proceed from the two Neighbouring *points* ſcarcely confound their *actions*.

XXVII. *How a Stone at the bottom of a Veſſel comes to be ſeen by the pouring in of Water.* If any one putting a *Stone* or *Counter* into a *Veſſel*, ſo place it, that he can no longer diſcern it, yet by pouring *water* into the *Veſſel*, directing his *Eye* preciſely to the ſame place, he will ſee the *Counter* or *Pebble* ſticking at the bottom of the *Veſſel*, tho' it did not appear there before.

To this there can be aſſigned no other Cauſe, than that the *Rays reflected* before from the *Counter*, there being then no ſort of Body interpoſed between, were directly ſent into the *Air*, and by conſequence ſmote nothing but the Forefront, and neighbouring parts of the *Eye*: But upon the infuſion of the *Water*, the *Beams* paſſing through it, are refracted, and ſo applying towards the *Eye*, render the *Stone* viſible and conſpicuous thereunto. Thus we ſee in the *refraction* of the *Rays* made in the *Horizon*, the *Sun* being 34 minutes high or thereabouts, appears much higher to us, than it would appear, if thoſe *Vapours* were abſent, through which the *Rays* of *Light* are tranſmitted, and conſequently being half a degree and 30 minutes diameter, it may be all ſeen, tho' depreſt and wholly underneath the *Diameter*.

XXVIII. *How things viewed through a Convex Chryſtal Glaſs appear.* Things appear bigger than they really are, through a *Convex Chryſtal Round*: As we find by experience in old *Men*, who being not able to diſcern *Letters*, tho' near at hand, help their *ſight* in reading, by uſing the *Convex Glaſſes* of a *pair* of *Spectacles*: As alſo in thoſe that make uſe of *Microſcope Glaſſes*, for the viewing and diſcerning of the *Hairs* of a *Flea*, and even the minuteſt and ſmalleſt *Bodies* imaginable.

The Reaſon is, becauſe in a *Convex Glaſs* plac'd between the viſible Objects and the *Eye*, the *Rays* which before came ſhort, and hardly reach'd the Ball of the *Eye*, are forc'd into the *Pupil*, ſo that the *Eye* receives the *Rays* from the *particles* of the Objects formerly hid; and ſince the *Rays* before join'd with them are ſeparated from thoſe interpoſed, and many *particles* ſeen from each part, they muſt needs be thereby inlarged, and repreſent the whole bigger. For when the *angle* is increaſt, the viſible Object coming next in view, by reaſon of the great divarication of the *Rays* entring croſs-ways the *Pupil* of the *Eye* toward the *Retin Tunicle*, muſt needs form a great *Image* in the bottom of the *Eye*.

XXIX. *Through a Teleſcope things appear greater.* Hence it comes to paſs, that through a *Teleſcope* or *Optick Tube*, we ſee things at a good diſtance, in their full *magnitude*, and diſcern them very diſtinctly. For this advantage a *Teleſcope* brings, that it cauſes the viſible Object, by reaſon of the great *Pupil* of the *Tube* to be diſcerned with more *Rays*, and by reaſon of the convexity of the utmoſt *Glaſs* gathering the *Rays* under a greater *angle* of Viſion. Moreover the divarication becomes great, of thoſe *Rays*, which entring *croſs-ways* the *Pupil* or utmoſt extremity of the *Tube*, towards the *Retin Tunicle* of the *Eye*, cauſe a large *Image* of the *viſible Object* to be deſcribed in the bottom of the *Eye*.

XXX. *Why from two Eyes any Object appears ſingular.* The Object appears ſingular, or but one, tho' tranſmitted to the *Brain* through both *Eyes*; and tho' the *Optick Nerves* meet not in conjunction, as appeared in the diſſection of a certain *Young Man*, in which VESALIUS found them to be ſeparate or divided.

The Reaſon of the ſimplicity of *Objects* is referred to the *Conarion* or *Pineal Glandule*, ſituate in the midſt of the *Brain*, in which the two *Images*, which proceed from the two *Eyes*, are united before they arrive at the *Soul*. For there is no other part in the *Brain* which is not double. For as for the *Cerebellum*, except in ſuperficies and name, it is not one: Nay, it is manifeſt that its

Vermiformous or Worm-formed *Proceſs*, and the Marrow of the *Spina Dorſi* conſiſts of four parts; two whereof proceed from the two *Medieties* of the *Brain*; the other two from the two *Medieties* of the *Cerebel*: But the tranſparent *Septum*, or Fence which ſeparates the two formoſt *Ventricles* is alſo double, and conſequently that *Pineal Glandule* only is ſingle, in which the *Species* proceeding from both *Eyes* may meet, before they are conveyed to the *Soul*.

XXXI. *Why the Picture of a Man ſeems to look upon all Perſons in the Room.*

A *Painted Perſon* ſeems to caſt an *Eye* upon every part round about him, and as it were to look upon every one in the Room particularly.

The Reaſon hereof is, that the *Eye* of the *Picture* is in plain, and conſequently the *Rays* may be brought from all its points to the *Eye* of the *Beholder*. But the *Eye* of the *Living Perſon* being of a Convex *Figure*, and a great part of it hid, it is not able to ſend out its *Rays* every way, as we find apparent in Carved *Images*, whoſe *Eyes* being exerted or ſticking out, and ſhapt into a certain Curvity or Convexity, cannot emit the *Rays* every way.

CHAP. VI.

Of Imagination.

I. *Whence ariſes the diverſity of Wit and Imagination.*

ALMOST all *Men* differ ſome way or other in *Wit*, and *Imagination*.

This chiefly proceeds from the various *Conformation*, *Figure* and *Magnitude* of the *Brain*, *Texture* of parts, *ſubſtance* and *motion* of *Animal Spirits*. For all theſe things very greatly conduce to the quickneſs or ſlowneſs of *Wit* and *Imagination*. Foraſmuch as if the bulk of the *Brain* be either leſſer or bigger than is fit, the *Wit* will either be precipitate or ſlow; either becauſe the *Spirits* themſelves have not a paſſage free and open enough, or becauſe the equal motion of them is put out of order through the default of the *Figure*; or perhaps becauſe in a larger bulk the Contexture of the *minute parts* is *courſer*, or there is ſome other more occult Cauſe, which repreſents the *Images* of things diſtorted or ill delineated.

II. *Whence proceeds the various Inclinations of Men, ſome to one Art or Science, ſome to another.*

Whence according to the various degrees of *Imagination*, *Men* are variouſly carried by a certain innate *Inclination*, ſome to the *Mathematical Arts*, others to *Eloquence* and *Poetry*, others to the Art of *Medicin*, that is, the *Practice*; for the *ſpeculation* thereof, which comprehends the *Principles* and *Rules* of *Medicin* more properly relates to the *Intellect* or *Underſtanding*; as the *Practick Part* of it which examins all the Indications and Circumſtances of a *Diſeaſe*, and takes opportunities of *healing*, belongs chiefly to the *Imagination*: Whence it happens that the moſt learned and acute *Phyſitians* are not always the moſt happy in curing of *Diſeaſes*. The ſame thing is for the moſt part obſervable in other *Sciences*: For thoſe *Men* who are the moſt Learned and Skilful in the *Law*, are judged the leaſt fit for other *Civil Imployments*.

III. *Many things occur to our Imagination, which never offered themſelves to our Senſes.*

Many things, through our inadvertency, occur, which before were never offered to our *Senſes*, nor left any *Veſtigium* of themſelves; as when, for Example, we conceive in our *Imagination* a *Hippocentaur*, and other *Chimæra's*, which never preſented themſelves to our *Eyes*, ſuch as we form'd them in our *Fancy*.

But tho' perchance thoſe things which we conceive in our *Imagination*, were not before in our *Senſes*, as to their *Compoſition*; nevertheleſs it cannot be doubted, but that the parts of which they were conſtituted, have at ſome time or other entred the *Brain*; or if haply not by themſelves, yet by ſome other thing which had a great affinity with them. For if a *Horſe* and a *Man*, for example, be repreſented to our *Eyes*, and the *Species* of both be impreſt upon the *Organ* of *Imagination*, we eaſily compound them together, and conceive a *Hippocentaur* or *Animal*, conſiſting of *Man* and *Horſe*. In like manner we may determin of the *veſtigia* of other *Objects*, by the *ſight* whereof we form many things which before fell not under our *Senſes*.

IV. *Why thoſe that look upon the ground from any high place, are taken with a Vertigo.*

They who, not being ſo accuſtomed, paſs over high *Bridges*, or from a high *Tower* caſt their *Eyes* upon the *ground*, are commonly taken with a *Vertigo*, and fancy all viſible *Objects* to turn round.

This proceeds from *Imagination*, which apprehends danger from the ſituation or poſture of the *Body*, and dreads the hapning of any miſchief to it, whence being very cautious how it tranſmits the *Spirits* into the *Nerves*, and how to direct them more ſecurely, it recalls them into the *Meditullium* or *inmoſt part* of the *Brain*, and ſo perverts them from their accuſtomed *afflux* and *Irradiation*; and while it indeavours to direct them into better order, overmuch ſollicitude compels them into a certain confuſion and irregular *motion*. And for this very Reaſon it is, that bold Perſons, and *Men* in *Drink*, in regard they take little care of the Regimen or Government of the *Animal Spirits*, ſuffer no ſuch *Vertigo*.

V. *Why Men in a Fever fancy they ſuffer thoſe things which they really do not.*

Some *Men* ſeiſed with a *Diſeaſe*, eſpecially thoſe in a *Fever*, fancy they do or ſuffer many things which indeed they do not: For I have known one in a *Tertian Ague* often complaining that he was grievouſly afflicted with a *wound* in his *Shoulder*, when at the ſame time he had in reality no *wound* at all.

This happens by reaſon that the *Species* which are impreſt by the courſe of the *Spirits*, or raiſed by means of the *Veſtigia* of the *Memory* are equally vivacious, and indued with no leſs ſtrength than thoſe which proceed from the *Senſes*. For when at that time the *Animal Spirits* are agitated above what health requires, they concur with the *Veſtigia* of the *memory* to the creation of other *Species*, which repreſent all things to us as being without us, and preſent to our *Senſes*. It alſo happens ſometimes in a *Diſeaſe*, that *Objects* make no impreſſion with which the *Mind* can compare thoſe *Species*, which the *memory*, or the force of the *Spirits* there ingender.

VI. *Witches in Imagination, ſee places far remote.*

Thus it is probable that *Witches*, buried in a deep *ſleep*, imagine they ſee Places far remote, *Towns*, *Cities*, *Palaces*, *Troops* of *Men* and *Women*, &c. and being awake deſcribe them to a tittle, as if they had ſeen them with their *Eyes*. Which doubtleſs is done by the help of the *Devil*, who repreſents the *Ideas* of thoſe things to their *Imagination*, and ſo ſtrongly imprints it in them, that they make no manner of doubt but that they were preſent at thoſe ſorts of *Shows*.

Some

G. Fremart

I. Kip Scu

To the Right Honorable Charles Sackvile, Earle of Dorset and Middlesex, Baron Buckhurst and Cranfield, Knight of the most noble order of the Garter, Lord Leivtenant of Sussex, Lord Chamberlaine of his Majesties Household, and one of the Lords of their Ma.tys most Hon.ble Privy Councell &c.a

This Plate is humbly Dedicated by Richard Blome.

VII. *What the cauſe is of marks imprinted in Births.*

Some *Marks* or *Characters* are imprinted in *Births* by the force of the *Mothers Imagination*; this appears in *Mothers* that long for any thing: For upon their touching of the *Cheek*, or any other part of the *Body*, the thing ſo earneſtly coveted, for example, a *Cherry*, *Grape*, or whatever elſe it be, is commonly impreſt in the ſame *member*. And FORESTUS makes mention of a certain *Noble Woman*, who, whilſt ſhe was with *Child*, having broke her *Arm*, brought forth a Male Child with a broken Arm.

The Reaſon hereof is, that the *Image* of the *Cherry* or *Grape* imprinted in the *Brain* of the *Parent*, is conveyed by the *motion* of the *Spirits* to the *Infant*, by reaſon that the ſame diſpoſition which inheres in the *Mothers Brain*, and moves in her the deſire of the ſaid *Fruit*, paſſes alſo into the *Brain* of the *Infant*, correſponding to the part affected: Whence the *Mother* touching her ſelf in that part, in the time of her *longing*, produces *there* the effect of her *Imagination*. Becauſe the *Mother* thus touching her ſelf, there comes preſently into her *mind*, the *figure* of the *Image* to be imprinted on the *Birth*; from whence a *motion* of ſome kind of *ſhame*, and alſo *fear* ariſes; without both which no *mark* is ever imprinted in the *Bodies* of any *Infants*. So alſo for the other Inſtance: For ſince every one of the Infants *members* is anſwerable to every one of the *Parents*, and the *Fibres* and *Humours* of both are continuous, no wonder if the *Male Child* of the foreſaid *Noble Woman* was born with a *Broken Arm*, and the ſame remedies being applied to the Arms of both *Mother* and *Infant*, both were ſeparately cured.

VIII. *The powerful force of Imagination.*

To the ſame cauſe may be referred what happened to an *Apothecaries Wife* at *Bononia*, who being with *Child*, and ſeeing through a *Window* in a *Neighbours Houſe*, *Snakes* flea'd, and hung to dry in the *Air*, brought forth a *Child* with a *Snakes Head*: So another *Woman* in *Sicily*, according to the Teſtimony of ALDROVANDUS, obſerving a *Lobſter* or *Sea-Crab* taken by a *Fiſherman*, and being taken with an earneſt longing for it, brought forth, together with the *Birth*, a *Lobſter* altogether like what ſhe had ſeen and long'd for.

IX. *A Party-Colour'd Child born of a white Woman.*

Hereunto may be added another *Hiſtory*, quoted by JOHANNES SWAMMERDAMUS in his *Treatiſe* entitled, *Uteri Muliebris Fabrica*, In which the force of *Imagination* in a *Woman* with *Child* is clearly demonſtrated. A certain *Woman* of *Utretcht* being with *Child*, and going to a Shop to furniſh her ſelf with ſome things for her Domeſtick Uſe, upon her firſt entrance, ſees a *Negro*, at which *ſight* being affrighted, ſhe went home, thinking no other but that ſhe ſhould bring forth a perfect *Black*. But at laſt recollecting her ſelf, ſhe borrows a *remedy* againſt this ſtrong *Imagination*, from another equally ſtrong, perſwading her ſelf that all the *Blackneſs* in her *Imagination* might be waſh'd off with *hot water*; in order whereunto ſhe kindles a *Fire*, heats a *Skillet* of *Water*, and waſhes her ſelf all over from *Head* to *Foot*. What follows? The time of her Delivery arrives, the *Child* is born, hath all his *Teeth* entire, and appears a perfect *White*, thoſe places excepted to which in the *Mother*, while ſhe waſh'd her ſelf, the *water* reach'd not; ſuch as in the *Hands* and *Feet*, the *Interſtices* or innermoſt parts of the *Fingers* and *Toes*, and ſome other parts of the *Body*, where there appeared manifeſt *ſigns* of blackneſs and black *Spots*.

X. *How it came to paſs that an Æthiopian Queen brought forth a White Child.*

PERSINA an *Æthiopian Queen*, beholding, in the midſt of *Copulation*, the Picture of a *White Child*, brought forth a perfect *White*; and on the contrary, another *Queen* an *European*, on the like occaſion, brought forth a *Negro Child*.

This ſome *Phyſitians* attribute to the *Seed*, which according to its various quality, induces various *forms*: So that if it be *Yellowiſh*, they will have it to produce a *Ruddy Colour*, if *Cinericious* or *Aſhes-like*, a *Brown Colour*; if *whitiſh*, a *White*.

Which *Opinion*, tho' it be common, yet in this matter, *Imagination* muſt claim the principal part. Becauſe in regard the *Nerves*, through which the courſes of the *Spirits* are inceſſantly carried, are extended from the *Brain* into all *parts* of the *Body*; the force of *Imagination*, eſpecially if it be a little more ſtrong than ordinary, by operating upon the *Bowels*, and exciting the *motions* of the *Humours*, may very well induce a *Black* or *White*, or any other *Colour*. So *Jacob*'s *Sheep*, according to the different aſpect of the *Rods* ſet before them, brought forth their *Young* of a various *Colour*.

XI. *Imagination performs wonderful things.*

By the certainty of this concluſion, HIPPOCRATES cleared a *Woman* that lay under ſuſpicion of *Adultery*, upon bringing forth a *Child* utterly unlike her *Husband*; finding that it was very like a *Picture* which hanging up in her *Bed-Chamber*, the ſaid *Woman* look'd upon very ſtedfaſtly in the time of Coition. For the ſame Reaſon is to be excuſed that *Lady* of the Noble Family of the *Urſini*, who brought forth a *Male Child* like a *Hairy Bear*, becauſe all the while ſhe was big, ſhe had very frequently before her *Eyes*, and conſequently in her *mind* the Pourtraitures of *Bears*, which are the Arms of the *Urſini*.

XII. *Deformed Whelps are to be removed from the ſight of bigbellied Women.*

Wherefore I judge nothing more blame-worthy among a ſort of light and wanton *Women*, than the great delight they take in *Whelps*, young *Apes* and *Monkies*, taking them up in their *Arms*, *hugging*, *ſtroaking*, and continually *handling* them, ſince by this frequent having them in their *Laps* and *Sight*, they habituate their *Imagination* to I know not what ſtrange and deformed *Ideas*, and ſo often bring forth a Birth that hath ſomething of an odd, ill favoured ſort of Meen in its *Countenance*. Wherefore I cannot but look upon it as very convenient that thoſe ſort of Dogs, vulgarly called *Camuſii*, ſhould be ſent away, that the ſight of them may not prejudice bigbellied *Women*, and be the occaſion of deformed *Births*.

XIII. *Why ſome delirant Perſons have always the ſame diſcourſe.*

Such a kind of *madneſs* poſſeſſes the *Minds* of ſome *Men*, and ſo perverts their *judgment*, that in their *diſcourſe* they have always one thing by the end, and neither give attention nor *anſwer* to the *words* of other *Men*. I ſaw a *Phrenetick* at *Paris*, who for a whole day together repeated the ſame *words* over and over again; and if by chance he was interrupted by any one, he would ſtare upon the *Perſon* ſo *ſpeaking* to him, as it were intending to *anſwer* him word by word, but no ſooner had the ſaid *Perſon* done ſpeaking to him, but he was at the ſame *Story* as before.

In ſuch ſort of *Men* it falls out, that ſo great a perturbation poſſeſſes the *Animal Spirits*, as to ſuffer the impreſſion of other *words* to adhere to

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the *Glandule*, but a very little ſpace, whereby it comes to paſs, that the firſt *Image* of things by which it is detain'd, immediately returning, they (as having forgotten the *words* laſt ſaid) are not able to give any *anſwer* to them, but only conformably to thoſe things which impel the *Glandule*, and are at that time repreſented to their *Mind*. For I am apt to think that theſe ſort of *Men* are not troubled with a *Phrenſie*, but only ſo long as their *Soul* has no command over the *motions* of the *Glandule*; or becauſe the *Animal Spirits* are in ſuch commotion, and are carried above it with ſo unequal a courſe, that they ſhatter it without meaſure, and raiſe upon it innumerable *ſpecies*, which preſently flow out and ſlip away. Or elſe, becauſe the courſe of the *Spirits* imbues the *Glandule* with ſome *Veſtigia* of *Memory* ſo tenaciouſly, that the ſame *Image* is always repreſented from which the *Soul* is not able to diſingage it ſelf.

XIV. *How it comes to paſs that ſometimes we are not ſenſible of things preſent.*

In like manner ſome *Perſons* are not ſenſible even of thoſe very *things* which their *Organs* perform, as it happens when the *Soul* is wholly taken up or diverted by any *ſtrong thought*, by reaſon that the *Animal Spirits* flow in ſo great a quantity through the *tract* upon which this *thought* depends, that thoſe which remain are no longer able to ſupply the tract, which the Object preſent indeavours to impreſs. For which Reaſon it is, that thoſe who are ſeiz'd with any acute pain, cannot poſſibly fix their *thoughts* upon any other thing but that.

XV. *Some Men are carried by their diſtemper to fancy themſelves Kings*

Some *imagine* their *Noſe* to be of ſo great a bulk, as not to be paſſable through any *Door*: Others believe themſelves to be *Kings*, as that *Spaniſh Servant* whereof JOHANNES HUARTUS makes mention, who verily believing himſelf to be a *King*, made many grave and wiſe Diſcourſes concerning *Government*. MONTANUS ſpeaks of ſome who fancied the ſurface of the *World* to be made of *Fine Glaſs*, and that *Serpents* lay lurking every where underneath the ſaid *Glaſs*; upon which conceit he kept his *Bed*, thinking himſelf there ſafe as in an Iſland, and that if he ſhould ſtir out of it, he ſhould break the *Glaſs* and ſo fall upon the *Serpents*.

The Reaſon of this extravagance may be drawn from what hath been ſaid; for whilſt by any tenacious diſpoſition of the *Spirits*, and certain firm *tracts* of the *Memory*, the *Glandule* is converted to that part of the *Brain* where the *pores* are opened; by the opening whereof the *Species* of *King*, *Serpent*, *Glaſs*, &c. may be revoqu'd, or elſe is form'd at that very time; the Soul beholding ſuch a *Species*, conſiders it ſelf as joined to that very *King*, *Serpent*, *Glaſs*, &c. which are repreſented by the ſaid *Species*, and as it were a *Compoſition*, making together with it one whole. I knew one at *London*, who took upon him to be *Archbiſhop* of *Canterbury*, ſo created by the *King*, and undoubtedly ordained to ſucceed the preſent Incumbent in that *See*, when as at the ſame time in all other things he ſeemed to be a perſon ſufficiently diſcreet and ſerious, and labouring under no other *Phantaſm*; for he carefully minded his own *affairs*, ſpent his time ſeriouſly and wiſely, and providently behaved himſelf in executing the Imploy he was ingaged in: All which I ſuppoſe may well enough be if the *agitation* of the *Spirits* by which the *Glandule* was formerly governed, ceaſes at that time, ſo long as nothing comes in its way that can renew thoſe priſtin *motions*, until the Fit returns, and a new acceſs comes upon the perſons affected as it were upon thoſe that are ſubject to a *feveriſh Diſtemper*.

XVI. *Of one that imagined he had Frogs in his Guts.*

A certain *Perſon*, when by chance fell into a *Well*, where there were abundance of Spawn of *Frogs*, and taking into his Body, by the fall, ſome of the *Well-water*, he afterwards took a deep conceit, of his having young *Frogs* in his *Belly*, that he could not be otherwiſe perſwaded for many years; in ſo much that for ſeven years together, he betook himſelf to the ſtudy of *Phyſick*, meerly for the finding out of a Remedy for this ſuppoſed Diſtemper; moreover he travelled into *Italy*, *France* and *Germany* to conſult the *Phyſitians* of thoſe Parts concerning the ſaid affair, ſtill fancying that the rumbling of his *Guts* was the *Croaking* of *Frogs*, nor was he otherwiſe cur'd at laſt but by deception; foraſmuch as a *Phyſitian*, acting above others by policy, conveyed live *Frogs* into his *Excrement*, and ſo made him believe that he had voided them by Stool. And all this while, ſetting aſide the recourſe of this *Imagination*, if it did recur, in all other things he acted very prudently, and made not the leaſt diſcovery of any extravagancy: Which might be, becauſe the *Animal Spirits* ceaſed ſometimes to flow through that tract of his *Imagination* where the extravagance was impreſt, as being diverted by ſome other occaſions; ſo that he appeared diſcreet enough till ſuch time, as upon the renewing of the cauſe, the acceſs of his *whimſical Fit* returned, that is to ſay, till ſuch time as ſome cauſe had diſpoſed the *Animal Spirits* to the ſame courſe.

CHAP. VII.

Of Memory.

I. *How it comes to paſs that Men differ in Memory.*

AS Men differ in *Wit* and *force* of *Imagination*, ſo alſo in *Memory*. For ſome there are who preſently get a *thing* by *heart*, and as ſoon forget it: Others get it ſoon, and firmly retain it: Others are ſlow in getting a thing into their *Memory*, yet when once gotten they do not eaſily loſe it. Laſtly there are who ſlowly learn a thing, but forget it ſoon.

As to the firſt ſort, they are *Men* who have *nervous Fibrils* ſufficiently thin and flexile, ſo that they eaſily receive the *Impreſſions* of the *Objects*, ſo that their *memory* ſoon gets hold of any *thing*; but then on the other ſide their *Brain* is too moiſt and diffuſed, ſo that the *Veſtigia* of what they had gotten are quickly effac'd, and conſequently they forget thoſe things they had *learn'd* juſt before. As to thoſe who ſuddenly get a thing, and alſo long retain it, they have a *Brain* moſt excellently well tempered, neither too *moiſt*, nor too *dry*, ſo that conſequently the *Fibrils* are wonderfully flexile, and thereupon the *Veſtigia* or *tracts* themſelves, are not, as in the former caſe, ſo ſoon effaced; and theſe *Men* are of all others of the happieſt temper. As to thoſe that ſlowly learn any thing, but long retain it, they have *thicker*, *ſtiffer* and leſs *flexile Fibrils*, whence they difficultly receive the

XVI.
Of one that imagined he had Frogs in his Guts.

I.
How it comes to pass that Men differ in Memory.

G. Freman. Inv. I. Kip. Scul.

To the most Honourable Henry
Marquess of Worcester,
& y Right Noble Henry Son and Heyre of
Duke of Beaufort &c.

This Plate is humbly Dedicated by Richard Blome.

the *Veſtigia* of the *Objects*, but withall they have a *Brain* ſufficiently temperate, in ſo much that the *Veſtigia* being there once impreſt, they remain there a long time; ſo that thoſe ſort of *Men* cannot eaſily forget a thing which their *memory* hath acquired. And as to thoſe who quickly drop or let go what they have ſlowly acquired, It is to be imputed to this, that the *Fibrils* of their *Nerves* are thicker and leſs flexil, and their *Brain* likewiſe intemperate, at leaſt either too *moiſt* or too *dry*; and theſe ſort of *Men* are of all others, of the moſt unhappy temper.

II. *Why Infants are deficient in Memory.*

Children and *Infants* are leſs indued with *memory*, and ſooner forget thoſe things which they have *learn'd*, than thoſe who are more advanc'd in *years*, or have arriv'd to their middle *Age*.

The Reaſon is, becauſe the *Memory* depends upon certain *Veſtigia* or *Tracts* in the *Brain*, after that the *Species* of any *thing* hath been impreſt upon it. Whence if it happens that any *parts* of the *Brain* are changed by accretion or diminution, thoſe *Veſtigia* muſt needs be all of them diſturbed, and ſome of them vaniſh. But whereas *Children* are continually growing, and ſomething of new *ſubſtance* always added to them, the *Pleits* in the *Brain* form'd by the tranſcurſe of the *Animal Spirits* are eaſily perverted and loſe their priſtin *Order*; as the *Pleits* or *Folds* in *Paper* are eaſily effaced if any of them be worn, or any new *ſubſtance* be ſuper-induc'd: To this may be added, that the *Brain* of *Children* is too ſoft and moiſt to retain tenaciouſly any thing committed to it. For tho' it eaſily receives things, yet it retains not any diſtinction of them one from another, being like nothing ſo much as *Mud* tempered with a great deal of *Water*.

III. *The Memory very prompt in Young Men.*

The contrary happens in *Young Men*, who having a *Brain* very well tempered, that is, neither too *moiſt* nor too *dry*; have alſo their *Fibrils* more ſubtile and flexil; and hence it is that the *impreſſions* of *Objects* are more eaſily received in their *Brain*, and longer conſerved; and hence it is that *Infants* are much more capable of new habitudes than thoſe of riper *years*, by reaſon that having the *Nerves*, *Muſcles* and the *Brain* more tender, the *Animal Spirits* might the more eaſily form their paſſages: Whence it comes to paſs, that *Infants* indeavouring and labouring to *ſpeak*, get, in time, ſo great a facility of expreſſing themſelves, that they pronounce their *words* with an incredible ſwiftneſs.

IV. *Some eaſily learn the things they hear.*

Some *Perſons* learn *Tunes* with little or no trouble, and afterwards without any ſtudy or labour of the *Brain*, expreſs them, ſo as to make true and exact *Harmony*.

This ſo happens by reaſon that the *Animal Spirits* acting within the *Brain* from the diſtinct accents of the *harmony* heard, are diſpoſed into peculiar *diviſions*, according to which, when they flow into the proceſs of the *Auditory Nerve*, like *Antomata*, as it were ſpontaneouſly, and by a certain ſucceſſion of *ſpecies* they eaſily expreſs the *Tunes* of the *Voice*, or *Inſtrument* which they had taken in with their *Ears*. So *Muſitians*, tho' intent upon other *affairs*, yet nevertheſs can ſo guide their *Fingers* to find out the *Muſical Stops* formerly taught them, that they touch the *Inſtrument* plaid on with wonderful skill, dexterity and ſweetneſs.

The *Smoke* of *Tobacco* getting up into the *Brain*, weakens the *Memory*, and cauſeth *ſtupidity* and *dulneſs*, an excellent example whereof we have had in a *Perſon* of extraordinary Learning and Ingenuity, and once endowed with an excellent *Memory*.

V. *The Memory of a certain Learned Man, hurt by taking Tobacco.*

And this might very well happen from the *Corpuſcles* of the fume ſuck'd in, which entring the *Brain*, obſtructed thoſe *Veſtigia* which repreſent the *Images* of *Things*, and conſequently rendred them uncapable of recalling any thing to *Mind*. Yet the ſaid *Fume* being exhaled and drawn out, he recovered his former faculty, and called to *mind* many things which he had formerly known; much after the Nature of an *Apoplexy*, by which the *Blood* being effuſed out of its *Veſſels* into the *ſubſtance* of the *Brain*, utterly obliterates the *Idea* of all things formerly known, no *Veſtigia* of them remaining in the *Brain*.

VI. *Old Men, tho' they eaſily forget what they did but a little before, yet firmly remember all the actions of their Youth.*

Old Men, when they arrive to their *decrepit Age*, are almoſt totally deveſted of their *Memory*, and ſcarcely remember any thing which they did but a little before. Yet at the ſame time remember the *Actions* of their *Youth*, retaining them firmly in *memory*.

The Reaſon why *Memory* decays in *Old Men* is, becauſe of the over-dryneſs of the *Brain*. For dry things cannot be eaſily wrought upon, ſo as to be able to receive *impreſſion*; or if they do admit of an entrance or impreſſion, they ſoon return to their priſtin ſtate, and recover their former diſpoſitions. But *Old Men* retain thoſe things which they have received into their *Memory* a long time ſince, becauſe the parts of the *Brain* are *hardned*, and its *pores* in which the *Spirits* formerly ran up and down, have acquired a certain facility of opening themſelves in the ſame manner at the preſence of any *object* upon the *Spirits* repairing to them. Hence it is, that they highly extol the times paſt, becauſe they have a remembrance of things done heretofore, but preſently forget late *actions* and *occurrences*.

VII. *How Artificial Memory may be obtain'd.*

Some Perſons willing to ſupply this natural defect of the *Memory*, have invented a way of *Artificial Memory*; as thus, having hired a *Chamber*, they hang upon the Walls thereof ſeveral *Pictures*, to each of which they apply their *Cogitations*, and afterwards when they have ſufficiently exerciſed themſelves in uniting certain *thoughts* with certain *figures*, they make uſe of this their *Artificial Memory*, as they grow older and older, thus habituating themſelves to recall this or that thing again into their *Memory*, according as they contemplate this or that *Picture*. For they cannot look on the ſaid *Picture*, but preſently there is excited in them that very *thought* which they had formerly join'd with the ſaid *Picture*: For thoſe things which are once joined in the *Mind*, remain joined there for ever.

VIII. *Why we cannot remember one thing without another to which it was join'd.*

Hence if any thing that we knew before ſlip out of the *memory*, and we call it afterwards to *mind*, that thing alſo preſently occurs which was joined with it. So that if any particular *Man* comes into our remembrance, we alſo call to mind the *injury* we have received, if we have received any from him.

The Reaſon is, becauſe when the *Veſtigia* of the *Memory* have brought the *Image* of any thing upon the *Glandule*, the *Spirits* in like manner

returning through the same *pores*, bring back also another *Species* to which the former was joined; whereby it comes to pass, that the *Spirits* flowing into the same *Muscles*, dispose our *Body* to put forth the same *actions* again, which it put forth upon occasion of the *Object* which first excited them, and this by experience we find to happen not only in *Man*, but also in *Beasts*; for if we receive with a good Cudgel, a *Dog* ready to fly upon us, and so put him to *flight*, the said *Dog*, if we afterwards meet him, tho' without any *Weapon*, will as soon avoid us, as if armed; because by the means of the *blows* wherewith he was formerly entertain'd, the course of the *Spirits* which our aspect excites, becomes joined with that course which the *Spirits* produc'd. So that those two ways meeting in the *Brain*, and being confused into one, it matters not which of them opens to effect the *motion* of the *Muscles*, and excite the said *actions*.

IX. *Our Memory is more vigorous in the Morning than in the following part of the day.*

Those *Things* which we revolve in our *Mind* in the *Morning*, we both more easily commit to *memory*, and more firmly retain, than whatsoever we think on the remaining part of the day.

The Reason is, because at that time the *Brain* is free, and not yet hindred by any *Vestigia* of things; for as in *Paper* a multitude of *Pleits*, and in the *Air* a great number of *sounds* brings confusion; so in the *Brain* the delineation of many *things* disturbs the *Vestigia*, and suffers them not to repose in their due places, nor to be perceived according to their proper nature. For the *Sense* being intent upon many *things*, is so much the more distracted and lessened, by how much the more it is imployed in contemplating several distinct *things*. Add hereunto, that the *Brain* in the *Morning* is less hindred with *Vapours*, in regard the concoction of *Meats* being now finish'd, the *Fibres* thereupon are the more expedite, both for quickning the *motions* of the *Brain*, and putting on a new affection.

X. *Things seen are better remembred than things imagined.*

We find always by experience, that we better remember those *things* which we have seen by a *Corporal View*, than what we have apprehended by the *Eyes* of Imagination; forasmuch as the *Nerves* which are the *Organs* of *Sense*, more invigorate the *Brain*, and impress in it deeper *Vestigia* or tracts than the *Animal Spirits* do which open the *Vestigia* of *Imagination*, and consequently we must of necessity more distinctly remember things seen, than things imagined; and for this reason it is that we know better the distribution of the *Veins* in the *Liver* upon the *sight* of one dissection of that part, than by reading it often times in a Book of *Anatomy*.

XI. *Some persons after a fit of Sickness, forget even the very Names of their Parents and Kindred.*

A Fit of *Sickness* or *Distemper* sometimes takes away all *Memory*, and so weakens that faculty, that they who before were indowed with an excellent *Memory*, after the said Disease scarcely remember any thing. PLINY makes mention of one, who falling from a high place, totally forgot, during the remainder of his Life, the *Names* of his *Parents*, *Friends* and *Kinsfolks*. And MESSALA CORVINUS after a great fit of *Sickness* forgot not only the *Names* of his *Relations* and *Domesticks*, but even his own *Name* also. Moreover a certain *Student* of MARSEILLES, after a *wound* received, so utterly lost his *Memory*, that he was forced to learn all over again, the first Rudiments of the *Arts* and *Sciences*.

The Reason is to be taken from the force of the *Distemper* or *Blow* given to the *Head*; which changes the *disposition* of the *Brain*, and perverts the *pores* formed by the means of the *Spirits*. Whence it comes to pass, that the *Vestigia* are expunged, or the contexture of the *Fibres* left in such a state, as renders it less apt for the foresaid Function. For as *Liquor* spilt upon *Paper*, washes out all its pleits or folds so utterly, that when the *Paper* is dry there are left no signs of them; so it may come to pass that the *Morbifick Humour* may so far prevail as to take away all the Pleits of the *Brain*, so that no *Vestigia* of them may remain which the *Sick Man* knew before. On the contrary, it may possibly happen, that they who before had a dull and heavy *Memory*, may from the same causes acquire a happy and lively one. As is related of *Pope* CLEMENT the Sixth, having so happy a *Memory*, that whatsoever he read he made absolutely his own, and never forgot it. The Cause of which Faculty PETRARCH ascribes to him from a *wound* given him in his *Head*, by which doubtless some *Obstructions* were dissolved, and the passages of the *Brain* opened, whereby a commodious way was made for the *Spirits* to pass to and fro. Another Person is mentioned by FULGOSUS, *Lib.* 1. *Cap.* 6. in the Reign of the *Emperor Friderick* the Sixth, who after breathing of a *Vein*, keeping his *Memory* intire in all other things, forgot to *Read* and *Write* as utterly as if he had never learnt either; But a year after, being let *blood* again, he recovered his knowledge of *Reading* and *Writing*, and became as it were a *new Man*.

XII. *Why very soon ripe Wits soon decay.*

In like manner it happens, that they who in *Youth* are brisk and active, when *Age* comes on, grow heavy and slow, and have little or no appearance of their former *Wit* and *Ingenuity*. Which proceeds either from the *Blood* vitiated, or from the *Obstructions* of the *Brain*, or from that *Nervous Liquor*, which being, according to the Modern *Physitians*, the *Vehicle* of the *Animal Spirits*, after too much *Agitation* or *Evaporation* grows flat. Hence oversoon ripe *Wits* which make such a clutter before their usual time, are not of long continuance, but in a short time decay and languish. Since such is the state of Nature, that those things which are best tempered, and to last a long time, are ripened by little and little, and as it were by degrees; so *Summer* Fruits soon decay, because the active principles of which they consist, quickly evaporate.

CHAP. VIII.

Of Slumbers and Dreams.

I. *How Sleep comes to be interrupted.*

Slumbers or repose of *Sleep* are for the most part interrupted, and but seldom hold out continued.

This hence proceeds, namely, because the *Spirits* being diversly agitated, and finding the *Vestigia* of various impressions, direct their course through such *pores*, rather than others. For the *Animal Spirits*

Spirits running through the Pleits of the *Brain*, render the *ſeries* of them in a manner inflate, and according to their various agitation, either move them with one ſingle *motion*, or skip from one to the other. Hence if it happen, that the *Spirits*, leaving one ſeries of the *Veſtigia*, skip firſt into one, then another, and ſo forward, various *Imaginations* muſt of neceſſity ariſe, which hang together by no connexion one with another; and yet they are all of a Company, tho' with ſome ſmall interruption. Whence ARISTOTLE compares ſuch *Impreſſions*, as are formed by *Sleep* in the *Brain*, to *Frogs* made of *Cork*, which being ſtuft with *Salt*, are plunged into the *Water*, where as ſoon as the *Salt* is melted, they ſeem to ſtruggle alternately, and without obſerving any Order, riſe up to the ſurface of the *Water*.

II. *Whether there be any that never Dream.*

ARISTOTLE in his Book of *Dreams*, Chapter the laſt, makes mention of ſome who are look'd upon as *Perſons* that never *Dream'd*; ſuch a one PLUTARCH mentions *Cleon* in his time to have been: And I my ſelf was familiarly acquainted with a Doctor of *Phyſick* at *London*, who proteſted often times to me that he never had any apprehenſion of any thing in a *Dream*.

Altho' ſuch ſort of *Men* never remember that they *dream'd* of any thing, yet nevertheleſs they cannot be ſaid to have been totally free from *Dreams*, for the *Soul* never wholly ceaſeth from *Cogitation*; and whatſoever Body is laid *aſleep*, that loſes not its *Eſſence* which is conſtituted in *Cogitation*. So that becauſe thoſe ſort of *Men* remember not that they had any *Nocturnal Cogitations*, it doth not therefore follow that they had none, ſince it many times happens to us not only to forget our *Dreams*, but even thoſe *thoughts* which we had *waking*, altho' in the mean time we may be ſufficiently aſſured that we ſaw in *Imagination*, or diſtinctly perceived ſomething in our *Dream*: So *Cleon*, and thoſe other Perſons mentioned by *Ariſtotle*, were not free from *Dreams*, but forgetful of thoſe things whoſe ſpecies were obliterated by reaſon of the *quality* of their *temperament*.

III. *How the Night Mare comes upon thoſe that are aſleep.*

Some in their *Sleep* fancy ſuch a load or weight lying upon them, as if ſome *Dæmon* lay heavy upon their *Breaſt*, and hindred the freeneſs of their *Breathing*. Hence this ſort of ſuppreſſion which the *Latins* call *Incubus*, is named by the *Greeks*, *Ephialtes* or *Inſultor*, we call it in *Engliſh*, *the Night Mare*.

The Cauſe of this *Nocturnal Aſthma* proceeds from the *Animal Spirits* being denied their influx into the *Nerves* and *Muſcles* deſigned for the *Organs* of *Reſpiration*; for if in *Sleep* the *Animal Spirits* have not their free Influx into their *Muſcles*, the like motion is induc'd; whence the *Soul* in ſuch an *affection* judges according to Cuſtom, as if ſome weight were incumbent, and hindred the *motion* of the *Diaphragma* or *Midriff*. Add hereunto that thoſe things which come into our *Imagination*, when *aſleep* or in a *Dream*, more ſtrongly affect the *Brain* than thoſe which are conveyed into it by the *Senſes* when *awake*. So while we indulge to *Sleep*, if *Spittle* abound in the *Mouth*, it follows that we ſeem to chew ſome certain *Meats*, and to maſh them with much Iteration, which never happens to us when we are awake. The ſame diſtemper may be cauſed when any thick *Vapour* fills the *Womb*, which by reaſon of its thickneſs cannot evaporate, but by an excited *heat* diſtends that part, whereupon the *Diaphragma* or *Midriff* is preſſed, and therefore cannot be ſo commodiouſly drawn down, eſpecially in the midſt of *Sleep*, wherein by reaſon of the leſſer influx of *Animal Spirits* it becomes leſs vehemently inflate, and is preſt downward.

IV. *The Cauſe of unchaſt Dreams,*

So the *Genital Humour* growing turgid in the *Spermatick Veſſels*, and agitating them with a certain irritation procures unchaſt *Dreams*; ſo the more groſs and undigeſtible ſort of *meats* being taken at *Supper*, in regard they ſurcharge and lie heavy upon the *Stomach*, cauſe diſturbances and frightful *Phantaſms* in the *Sleep*.

V. *How it comes to paſs that ſome riſe out of their Bed, and walk in their Sleep.*

It is uſual with ſome perſons to riſe out of *Bed* at *Midnight*, and have recourſe to thoſe places and do thoſe actions, which awake they would not dare to venture on; ſome hurry up and down, and without any help or aſſiſtance climb up *Trees*, and get up to *Houſe-tops*. HORSTIUS makes mention of a certain *Nobleman*, who climbing up a High *Tower*, and ranſaking the *Birds-Neaſts* there, got down again by the help of a Rope.

Phyſitians are of opinion that theſe things proceed from *turgid Blood*, and an Effervеſcence of the *Spirits*, which being carried into the ſeat of the *Mind*, agitate thoſe *Inſtruments* of *Motion*, and impel them to perform thoſe effects; whence it comes to paſs, that the Body by the impulſe of the *Animal Spirits* is wrapp'd up in *Imagination*, and by vertue thereof is incited to ſuch *actions*: But I am of opinion, that all theſe things would ſignifie nothing without the help of *Imagination* which in a manner alone performs and brings to paſs all theſe difficult things. For *Imagination* is not only incited by *External Objects*, but alſo by thoſe *things* which are repreſented in *Sleep*, whence being agitated by the reſerved *Species* of *things*, it both excites extraordinary motions, and impels to the performance of thoſe things which ſtrike both *admiration* and *aſtoniſhment* into the *Beholders*.

VI. *An Example brought of* Galen *and others.*

It is reported of GALEN, that ſometimes he walk'd almoſt a whole furlong in his *Sleep*; and of a *Servant* of *Pericles*, that he uſed frequently in his *Sleep* to walk upon the *Houſe-top*. Others make mention of a *Schoolmaſter*, who, in his *Sleep*, not only was wont to teach his *Scholars*, but went one time armed to kill a *Colleague* of his by whom he had been ſharply reproved, of which when he wak'd he remembred not any thing. Moreover, ſome *perſons* of undoubted credit have delivered a relation of two Young Men, whereof one tho' wholly ignorant of the Art of *Swimming*, yet uſed to riſe in his *Sleep*, repair to the *water* and *Swim*; the other was alſo a *Nightwalker*, who one time above the reſt, went down into his *Maſters Kitchin*, and there in preſence, and to the admiration of ſome of the *Servants*, not yet gone to Bed, ſpitted the *Brooms* like joints of *Meat*, and laid them to the *Fire*; thus he beſtirred himſelf, till at laſt waking, and being aſhamed of what he had done he ſneak'd away to *Bed* as faſt as he could. And all theſe things proceeded from the heighth of *Imagination*, and the perſons deeply fixing their *Minds*, each of them upon the things they acted, whereby the paſſages through which the *Animal Spirits*, firſt entred, remained ſo wide and open, that the ſame *Spirits* at length inſinu-

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ated themſelves, and the *Soul* by their motion became affected in like manner.

VII. *Dreams are uſually of thoſe things which were thought on in the Day time.*

In *Dreams* the ſame *imployments* and *actions* run in our *Minds*, upon which we were intent and buſied the day before.

The Reaſon is, becauſe the parts of the *Brain*, which have formerly been ſhatter'd by the acting of an Inferior Object, are more eaſily moved by the *Animal Spirits*, than thoſe which have always remained quiet; whence when the *Veſtigia* of thoſe things which we have firſt *imagined*, are diſcovered and remain after a ſort laid open, the *Spirits* running ſlightly over them, bring back thoſe *Images* of the Soul which it impreſt upon it when *awake*. Wherefore unleſs the *Body* be indiſpoſed and diſturbed by *noxious Humours*, no other *Cogitations* can be offered to the *Mind* than thoſe which poſſeſt it *waking*.

VIII. *How it happens that ſome in their Sleep let go their water.*

Some *perſons* in their *ſleep* emit their *Urin*, and as if they were ſtanding againſt a *Wall*, or holding a *Chamberpot* in their hands make *water*.

This never happens but when the *Bladder* ſwells with fulneſs, and is extended beyond its uſual extenſion, becauſe then the *vellication* of the *Sphincter* ſo opens the *pores* in the *interiour ſuperficies* of the *Ventricles* of the *Brain*, that the *Spirits* running to and fro above the *Glandule*, take their courſe toward thoſe *Nerves* which are inſervient to the emitting of the *Urin*, and thereby procure ſuch a motion, that not only the appetite of *making water* is produc'd, but alſo the *Image* of the *Wall* or *Chamberpot* is preſented, which they that thus *dream* were wont to make uſe of upon this occaſion.

CHAP. IX.

Of the External Paſſions.

I. *Sanguine Perſons are chiefly prone to Laughter.*

MEN of a *jolly Temper* and *ſanguine Complexion*, upon any the ſlighteſt occaſion, burſt forth into *Laughter*, nor are they, when any one elſe *Laughs* able to contain themſelves, or when any matter of *ſport* or *merriment* comes into their *Mind*.

This ſort of Paſſion in Men of this Conſtitution ariſes from the moveableneſs of the *Fibres* which are ſtirred up, and as it were friſk at the occurrence of any *ſportive Object*, by which affection drawn through the *Diaphragma* or *Midriff* a certain change of the Countenance with a *ſonorous* and *inarticulate Voice* is created. For herein conſiſts the reaſon of *Laughter*; that the *Blood* paſſing from the *right Cavity* of the *Heart* through the *Vena Arterioſa* ſuddenly, and with a repeated *ſhaking*, puffs up the *Lungs*, and cauſes the *Air* which they contain, to be compelled to break forth forcibly through the *Aſpera Arteria*, in which it forms the *Inarticulate* and *Sonorous Voice*, and as well the *Lungs* by being inflate, as this *Air* by going out impel all the *Muſcles* of the *Diaphragma*, *Breaſt* and *Throat*, by which means they move thoſe *Muſcles* of the Countenance that have any connexion with them. Wherefore no wonder if many times perſons of great *Senſe* and *Ingenuity* cannot contain themſelves, tho' uſing their utmoſt means to repreſs the ſaid *Motions*.

II. *Whence ariſes the Impulſe of Animals to Venery.*

By the *impulſe* of *Nature* it is that *Animals* are carried to *Venery*, or as it were forc'd by a certain violent inclination to a conjunction with their like, for the *propagation* of their *Species*.

This *Inclination* of *Animals* hence ariſes, namely, becauſe at their fit Age the *Seed* increaſt in the *Veſſels* appropriate to *Generation*, and the *receeption* of the ſaid *Seed* upon ſome acceſs of heat from the afflux of the *Spirits*, provokes *Concupiſcence*, which in *Males* from the ſight of the *Female*, and on the contrary in *Females* from the preſence of the *Male*, by a vehement agitation of the *Animal Spirits*, impels *Animals* by a certain *amorous rage* to a *Mutual Conjunction*, with which they are inflamed, much after the ſame manner as a rapid *Fire* ſhut up in a cloſe *Fornace*.

III. *Whence Sardonic Laughter proceeds.*

There ſometimes happens to one a *Laughter* againſt his *Will*, even in exceſs of *pain*, or elſe at the point of *death*; and ſuch a kind of *Laughter* is called *Canine* or *Sardonick*.

Old Women impute this ſort of *Laughter* in *Infants* to a ſign of *Joy*, when indeed it is nothing but a Convulſion of the *Muſcles* of the *Face*, which is very often attended by *Epileptick Fits*. So likewiſe among *Gladiators* and ſuch ſort of *Combatants* it is a moſt certain ſign of inſtant *death*; foraſmuch as it denotes that the *Animal Spirits* are no longer under the *Government* of the *Mind*, but in a tumultuary manner ruſh ſometimes upon theſe, ſometimes upon thoſe *Nerves*, and ſo that the Link of the *Mind* with the *Body* is almoſt broken.

IV. *How it come to paſs the Mens Hairs ſtand on end who are ſtruck with horror.*

When any one is ſtruck with *horror*, his Hair (as it were) ſtands on end. Becauſe when the *Blood*, by reaſon of the ſaid aſtoniſhment, withdraws to the *Bowels*, the external parts of the *Body*, eſpecially the *Skin*, are contracted; nor can it be but that by the contraction of the *Skin*, the *pores* alſo are compreſt, and thereupon the *Hairs* ſtart up. Becauſe the *pores* of the *Body* are like *Repoſitories* in which the *Hairs* are diſpoſed, which according to their different ſituation, obtains a various *poſition*. The ſame effect is ſtirred up in other *Animals* by the motion of ſome affection or other; as for example, *Anger* in a *Dog*, fear in a *Hen*, whoſe *Feathers* riſe up amain, if the *Enemy* be at hand ready to ſeize her.

V. *Some after a full Meal fetch deep Sighs.*

In ſome it is obſerved, that after *Meat*, from the fulneſs of their *Stomach* they fetch deep ſighs, and draw their *Breath* from the very bottom of their *Breaſt*, like perſons affected with ſome languiſhing diſtemper.

This I judge proceeds from a motion which *Nature* makes uſe of, the ſooner to tranſmit the juice of the *Meats* through the *Heart*, to the end the *Stomach* may the more ſpeedily be relieved by them. For *ſighs* by agitating the *Lungs*, cauſe the Blood which is contained therein to flow the more ſpeedily through the *Arteria Venoſa* into the *left Ventricle* of the *Heart*, and thus the new *Blood* created of the *Meats* juice flowing from the *Stomach*, the *Lacteal Veins* and *Heart*, as far as the *Lungs* may the more eaſily be admitted into it.

VI. *Why of ſad Perſons, ſome covet Meat, others refuſe it.*

In ſome *Perſons* affected with *Sadneſs*, the *Appetite* being quite taken away, all ſorts of *Meat* become loathſom to them. On the other ſide, others *languiſhing* with *ſorrow*, covet *Meat* with a more ſharp and greedy propenſity,

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The difference ariſes from the different *original* of theſe two ſorts of *ſadneſs*. The original of the firſt, which affects ſome from their very Birth, is from hence, namely, becauſe they took not in *nouriſhment* enough, but were kept ſhort of ſuch an allowance of *Meat* as might ſatisfie the appetite. Of the Second ſort, that the *nouriſhment* they firſt took was grievous and hurtful to them, and thereupon the motion of the *Spirits* in them which takes away the deſire of *Meat*, remain'd join'd with *ſadneſs*. For ſuch is the *Conjunction* of *Body* and *Soul*, that theſe very *Cogitations* which have accompanied any *motions* of the *Body* from the very firſt entrance into life, continue to accompany them.

VII. *Suddain Joy cauſes Swooning and Fainting away, and ſometimes even to death.*

Some fall into *ſwooning fits* upon their being ſeiſed with exceſs of joy, as for example, that *Woman* mentioned by VALERIUS MAXIMUS, who at the ſight of her *Son*, whom ſhe thought to have been long ſince ſlain in *Battel*, fell immediately *dead*. I have heard of a certain *Merchants Wife* in *England*, whoſe *Husband*, taking a voyage into the *Eaſt-Indies*, was by ſome Friends reported to be dead, that when after three years ſhe heard that he was returned, and even juſt at the very doors to enter, ſhe running haſtily to meet and embrace him, fell down dead on the Threſhold at her *Husbands Feet*.

The cauſe of this I judge to be, for that the ſaid exceſſive, ſuddain and unwonted *joy*, by opening the *orifices* of the *Heart*, forces the *Blood* of the *Veins* to enter with ſuch violence, and in ſuch abundance into the *Heart*, that it could not be there dilated and rarefied ſoon enough to remove thoſe *valvules* which cloſe the *Orifices* of the ſaid *Veins*, whereby it came to paſs that the *Fire* in the *Heart* was ſuffocated, and the *Life* which conſiſts in the motion thereof periſht.

VIII. *Why upon the Yawning of one Perſon, others alſo Yawn.*

It happens very often, that upon the *yawning* of one *Perſon*, the reſt of the Company fall a *yawning* or *gaping* alſo.

Oſcitation or *Yawning* is nothing but the deduction or parting aſunder of the lower *Jaw* from the upper, which diduction proceeds from ſome ſharp particles there ſticking and gently vellicating the *Fibrils* of the *Nerves*, whereby the *Spirits* have a more copious influx towards thoſe *Muſcles* of the *Mouth*, and ſo produce the ſaid *motion*. But that upon one Perſons *Yawning*, others ſhould do the like, it proceeds from no other cauſe but this, namely, that the ſaid *diduction* of the *Jaws* ſo diſpoſes the *Animal Spirits*, that they ruſh towards that part, and ſo excite an *Oſcitation* or *Yawning* together, much after the ſame manner as two *Muſical Chords* or *Strings*, which being ſcrew'd up and *tun'd* to the ſame *note*, ſo *ſympathiſe* together, that when one being ſtruck ſends forth a *ſound*, the other at the ſame time, though not ſtruck, ſends forth the ſame.

IX. *How it comes to paſs that Perſons exceſſively grieving, fall into a Swoon.*

A *Lipothymie* or *Swooning away* through failure of the *Spirits*, oftentimes proceeds from great *grief*.

The *original* of a *Lipothymie* is when the *Animal Spirits*, be it for what cauſe it will, are carried impetuouſly through the *Nerves* to the *Heart*, and contract its *Ventricles* at that very time when they ought to be dilated by the *Blood* entring in; whence it comes to paſs, that the *fermentation* of the *Blood* is hindred, and conſequently that the *Blood* within the very *Ventricles* of the *Heart* cannot be ſufficiently rarefied, nor ſtrongly enough thruſt out into the great *Arterie* adjoining; whence it is that this *Lipothymie* proceeds from great *grief*, in regard the whole contexture of the *Nerves* is thereby ſhattered, and conſequently the *Arteries* themſelves that receive the *Ramules* or little *Branches* of the *Nerves* are alſo ſhattered, whereupon the *Blood* contained in the *Arteria Magna* or *Great Artery* is forc'd upward towards the left *Ventricle* of the *Heart*, and thereby hinders the *Blood* contained therein from being able to paſs. This is the true cauſe of the *Lipothymie* or *Swooning Diſtemper*.

X. *How it comes to paſs that Perſons affected with Sadneſs or Grief, are apt to ſhed Tears.*

Thoſe that are *ſad* and *dejected* of *Mind*, are very prone and apt to ſhed *Tears*, eſpecially if the heavineſs of *Heart* be not very exceſſive, and any ſenſe of *Love* attends it.

The Reaſon is, becauſe tho' from all parts of the *Body*, *Vapours* exhale, yet there is no part which ſends forth more than the two *Eyes*, both in reſpect of the magnitude of the *Optick Nerves*, as alſo the multitude of the *little Veins* through which the ſaid *Vapours* tend thither. But, whereas *ſadneſs* by cooling the *Blood*, contracts the paſſages of the *Eyes*, and keeps back the agitation of *Vapours*: *Sadneſs* alone is not ſufficient to draw forth *tears*, unleſs there be alſo an acceſſion of *Love*, which is an occaſion of diſcharging the *Blood* towards the *Heart*, and of increaſing the quantity of *Vapours*: Whence it is obſervable that the *Sad* do not ſhed *tears* continually, but only by *Intervals*, whilſt the *Object* they *love* recurs to their *Mind*, and is repreſented anew to their *Imagination*. The *Ancients* have allowed this expreſſion of *Grief* even to *Brute Animals*. *Horſes*, ſaith PLINY, bewail the loſs of their *Maſters*, and weep for want of them; and concerning the *Horſe* of ſlain *Pallas*, *Virgil* thus writes.

The War-Horſe Æthon, ſpurning now aſide
His Warlike Trappings, Ornaments of Pride,
Weeps as he goes; and for reſentment ſour,
Down from his Cheeks the great drops trickling pour.

XI. *How it comes to paſs that thoſe who weep, not only ſhed Tears, but alſo ſend forth loud Shrieks and Out-crys.*

A loud *Outcry* is oftentimes adjoined to *Weeping*, eſpecially in *Children* and *Women*, who, tho' they are both prone to *Laughter*, yet ſend forth louder and ſhriller *Crys* in *Weeping* than in *Laughter*.

Theſe *Shrieks* are produc'd when the *Lungs* are in a moment puſt up by the abundance of *Blood* entring into them, which expels from thence the *Air* that filled them, which *Air* being tranſmitted through the *Throat*, produces thoſe *howlings* and *crys* which accompany *weeping*. But becauſe the *Nerves* that are inſervient to the dilating or contracting the *Organs* of the *voice* to render the ſaid *Voice* more acute or gracile, are joined with thoſe, which in time of joy open the *Orifices* of the *Heart*, and in *ſadneſs* contract them: Hence it comes to paſs, that theſe *Organs* are at that time dilated or contracted. Hereupon in *weeping* the *Brows* are contracted and depreſt, the contrary whereof we find in *Laughter*.

XII. *Why Lovers so often sigh.*

Lovers commonly fetch deep *sighs*, and as an argument of their solitude and grief, pant and draw their *Breath* thick from the bottom of their *Breast*.

The Reason is, because in *Love* the *Imagination* of *Hope* or *Joy* opens the *orifice* of the *Arteria Venosa*, which *Sadness* had before contracted. Wherefore when that small quantity of *Blood* which remained in the *Lungs*, is in a moment conveyed through this *Vena Arteriosa*, into the left *Cavity* of the *Heart*, and is impelled thither, by a desire of obtaining that *Joy*, where at the same time all the *Muscles* of the *Midriff* and *Breast* are agitated; it comes thence to pass, that the *Air* is very quickly impelled through the *Mouth* into the *Lungs* to possess that place which is forsaken by the said *Blood*.

XIII. *How it comes that the Sad have not always in their Countenance the same Colour*

The *Sad* carry not always the same Countenance; for sometimes they look *Pale*, other times are of a *Ruddy Colour*.

Sadness inclines to Paleness, when by contracting the *Orifices* of the *Heart* it causes the *Blood* to flow more slowly into the *Veins*, and as being made colder and thicker, to possess less place; whereby it comes to pass, that betaking it self into the broader *Veins*, and those neerest the *Heart* only, it forsakes the remoter, whereof the most conspicuous are those in the *Face*: And by this means the *Lover* is rendred the more *Pallid* and *Macilent*. But when the *Sad* look Red, and discover a certain Ardour in their *Countenance*: It is not so much to be imputed to *Sadness* as to other *Affections* which are joined to this *Passion*, namely, *Love* or *Desire*, or possibly sometimes *Hatred* it self. Forasmuch as these *Passions* moving and heating the *Blood* which proceeds from the *Liver*, *Entrails*, and other interiour *Parts*, and impelling it first to the *Heart*, thence through the *Aorta* to the *Veins* of the *Face*, cause the said *Face* to look Red and High Colour'd.

CHAP. X.

Of some Persons Natural Inclinations and Aversions.

I. *How it comes to pass, that of two Gamesters we favour one more than the other.*

IF by chance we fall into the Company of two *Gamesters* equally unknown to us; We by I know not what *Instinct* of *Nature* are apt to favour one more than another: And so likewise if we see two *Persons playing* at *Tennis*, we wish success to some one of them rather than the other.

The *Peripateticks* impute the Cause of these *Natural Inclinations* and *Aversions* to that which they call *Sympathy* and *Antipathy*; which obscure and insignificant Terms, serve only for one main end, namely, for a Cloak to cover our *Ignorance* under the umbrage of a few large striding and big swelling words. We therefore assert, that this *Inclination* whereby we favour one Party rather than another; if this propension continues no longer than the *Game* lasts, proceeds from hence, *viz.* that our *Will* which flies all Indifference, and affects to be concerned about some or other *Object*, takes an occasion to join it self to some *Party*, altho' the *Soul* be induc'd by no apparent Reason, more to favour one than the other, or to wish success on any particular side, but only suffers it self to be drawn over towards that *Dice-thrower*, or *Tennis-player*, who at that time most sweetly sooths his *Brain* according to the tenour of its disposition. But if this *Affection* survies the *Game*, and after the Match ended remains still fixed in his *Heart*, it proceeds from the *Vestigia* or tracts of the *Inclinations*, the original whereof I have shewn in my *Institution of Philosophy*, *Part* 9. *Cap.* 14.

II. *Why we should so favour, when nothing occurs that should impel us to it.*

But if we remember not the agreement or similitude which the *Objects* we *love* or *reject* at present, have with those which we formerly had a *love* or *aversion* for, it is because the first *Passions* out of which the Second proceeded, were mightily confused, as being the very first *Passions* of our *Infancy*, or at least such as we no way ever considered with attention, and were of the number of those whose *Object* we *loved* or *hated*, without any trial or weighing of Reasons, or Animadversion of what might be worthy in them of *Love* or *Hatred*. Wherefore the Second also are partakers of the same obscurity and confusion as the First; and we are very often forc'd to say with the Poet,

I love thee not Labidius, *say no more;*
I love thee not, but cannot tell wherefore.

III. *Whence it is that many have an aversion to Cheese.*

There is scarce a *Country* or *Province*, in which there are not many persons who have not an extraordinary aversion to *Cheese*, of whom some there are, who not only have a great abhorrence from the *eating* of it, but also cannot without much trouble and offence behold the sight of it.

IV. *Sir* Kenelm Digby's *Opinion.*

The Cause of this *Aversion*, Sir KENELM DIGBY judges to be, for that *Children* many times are suckled by *Nurses* with *Child*, and in whose Breasts consequently by reason of a new conception the *Milk* is curdled, which may possibly offend the *weak Stomach* of the *Infant*. For without doubt a very great alteration must needs be made in the *Milk*, by reason of the *Nurses pregnancy*; and the *Milk* thus corrupted being suck'd in by the *Infant*, degenerates in his *Stomach* into a vitious *curdle* of *Cheese* grievously distasteful to the *Childs* weak *Stomach*; whereupon this aversation sticks upon it as a lasting brand during the Parties whole life. So a certain *Lawyer* in *London*, going to sup up a *Rear Egg*, and chancing unawares to swallow the *Embrio* of a *Chicken*, entertained from that time forth such an aversion for *Eggs*, that upon no occasion, nor by any perswasion of *Physitians*, could ever be brought to eat any more *Eggs*. This cause for nauseating of *Cheese* in many, I can well enough allow, but that all who suck coagulated *Milk* should for this cause only have this aversation I can never admit, when as we daily see a vast number of *Women*, especially of the common and meaner sort so fruitful, that they bring *Children* every year, whom they suckle at the time of their being with *Child*, and never wean them till they are near their time. So that if all the *Children* who have suck'd the *Milk* of *Big-bellied Women*, should be initiated in this aversion for *Cheese*, and increase it with their *Age*, how vast would their number be? And in how short a time would *Cheese* grow cheap?

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V. *A more probable Opinion.*

Wherefore my Opinion is, that there may be another cauſe of this *Averſion*, either their *Mothers Longing*, or greedy deſire of certain *Meats*, which when they cannot be obtained, the *Infants* ſoon after born, abhor and loath them, or elſe becauſe *Cheeſe*, eſpecially *Old Cheeſe* abounding with *Volatile Salt*, and many other putrid *particles*, might poſſibly raiſe ſuch a confuſion of *particles* in the *Blood*, that great inconveniences might thereupon ariſe, eſpecially to *Infants*. What wonder therefore, that this effect ſhould be continued in *Adult* or full grown *Perſons*? So far as that the very ſmell of *Cheeſe* cannot be indured by many. Nay, though it be fraudulently mixt with other *Meats*, and adminiſtred to the Party not knowing the *cheat*; nevertheleſs it will either cauſe a violent Vomiting, or if that happen not, many inconveniences and diſturbances will thence ariſe.

VI. *How it comes to paſs that ſome are ſo impatiently affected with the ſtink of a Candle careleſly put out.*

A certain *Nobleman* of *England*, of my particular acquaintance, had ſo great an abhorrence of the *fuming ſnuff* of a *Tallow Candle* put out, that if by chance it hapned at any time through the negligence of the *Servants* to be careleſly blown out, and not covered with an *Extinguiſher*, he was ſo diſturbed with the *ſmell* thereof, that he became all of a *ſweat*, and was diſcerned to tremble every Joint of him.

This could not happen to him upon any other account, than becauſe this *Organ* of *Smelling* was ſo attempered according to the inſenſible *particles*, that the more *ſubtile particles* of the ſaid *Fumous Vapour* begat in his Noſe an ungrateful *motion*, that is to ſay, a moſt abominable *ſmell*, much in the ſame manner as *Smoak* falling into the *Eyes* provokes to *Tears*, and *pricks* and *velliteates* the *Tongue* it ſelf.

VII. *How it happens that ſome mightily abhor the ſight of a Cat, or ſuch like Animal.*

Some Perſons can by no means indure the ſight of certain *Animals*; nay, are highly diſturbed if they happen to be in the ſame place where they are, tho' not ſeen; particularly ſome have ſuch an averſion for the preſence of a Cat, that at the ſight thereof they fall into a Swoon.

This may very well be, for that when they were yet *Infants*, and in their tender years, they were hurt by a *Dog*, *Cat*, or ſome other noxious and hoſtile *Animal*, tho' perhaps retaining no memory of the Wound inflicted, and conſequently they may experiment in themſelves, at the firſt ſight of the *Animal*, the ſame commotions as well of *Body* as of *Mind*, with which heretofore they were affected, either upon the foreſaid occaſion, or elſe becauſe their *Mothers* when they bore them in the Womb, were affrighted at the ſight of the ſaid *Animals*; or laſtly, becauſe their temperament of *Blood* and *Spirits* is ſuch, that the Evaporation continually exhaling from the Body of the *Cat*, and tranſmitted by reſpiration, coagulates, fixes, and after an unwonted manner exaggerates the *Blood* and *Spirits* with which it is intermixt. Whence no wonder they undergo ſo great a perturbation, and ſometimes fall into a *Swoon*. If other *Men* have the fortune not to be taken with theſe *Paſſions*, it is becauſe they are of a different temperament, and are not affected with the exhalement of the *Cat*, evaporated by the circumambient *Air*.

VIII. *How it come to paſs that ſome abhor the ſmell of Roſes.*

Upon the ſame ground we muſt ſuppoſe that OLIVER CARAFFA abhorred the *ſmell* of *Roſes*, when every year in *Roſe* time he was forced to withdraw from *Rome*, and live recluſe among the *Gardens* in the *Quirinal*, *Guards* being ſet at his Gates to hinder any of his *Friends* and *Viſitants* from carrying in a *Roſe* with them. In like manner a certain *Engliſh Lady*, mentioned by Sir KENELM DIGBY had ſuch an abhorrence to the *ſmell* of *Roſes*, that when one of her acquaintance put a *Roſe* upon her *Knee* when ſhe was *aſleep*, to try whether ſhe had ſo great an *Antipathy* to that *Flower* as was reported; there grew *Pimples* immediately upon the *Place*.

IX. *The Reaſon of this Averſion.*

The *Original Cauſe* hereof might be from a ſtrong *ſcent* in the *Mothers Womb*, or in the *Cradle*, or haply ſome other place, tho' totally forgotten; by which the temperament of the *Brain* hath been hurt, and the *Mind* affected with trouble and diſturbance. And theſe or the like *affections* as well of the *Body* as of *Mind*, may eaſily be allowed, tho' a long time after, to ſurvive, in the Parties, the *Original* Cauſe. To which we may add, that in regard the *Fibres* of the *Senſory* or *Organ* of *Smelling* are according to the diverſity of *Men*, diverſly configurated: It thence comes to paſs, that things of any *Odour* or *Smell*, affect not all perſons alike, ſince that ſome *Objects*, as being indued with rough and pungent Effluviums, are by ſome accounted ſordid and odious, which very things to others that have notable ſtrong and tough *Fibres* in that *Senſory*, are ſweet and grateful. I know a great *Lady* that takes much delight in the *ſmell* of *ſtinking Fleſh*, and admires the *fuming Snuff* of a *Candle* new put out.

X. *Of one who abhorred a Waſp.*

A *Gentlewoman* in *Oxford* hated a Waſp to that degree, that in the hot *Summer Months*, when Waſps fly frequently about in *Houſes*, ſhe uſed to keep her ſelf cloſe ſhut up in a *Chamber*, not daring to ſtir out into a *Dining Room*, or any ſuch like large or open place, till ſuch time as ſhe had news from thoſe that ſhe durſt give credit to, that this ſort of *Inſect* was deſtroyed, or at leaſt was no longer ſeen.

This *Averſion* probably hapned to her from ſome miſchief or incommodity ſhe had received from this kind of *Animal*: As they who having *drunk* for a *Medicin* ſome kind of *bitter Potion*, take ſuch a diſtaſt from thence forward at it, that they will not indure to taſte, nor even to behold, nay not ſo much as to look upon any thing that is like it. Likewiſe there goes a Report of a *French Nobleman*, who had ſuch an *Antipathy* to *Garlick*, that he could not *taſte* the leaſt Crumb of it without *Vomiting*; and after he had with good ſatisfaction made an end of a Meſs of *Broth*, into which, for his ſake, no *Garlick* was put, yet when one of the Company, to play the Wag with him, told him there was a little *Garlick* ſhred in it to give it a reliſh, he vomited up both the *Broth*, and all that he had eaten beſides.

All

XI. *How it comes to pass that Men have various Natural Inclinations.*

All Persons by Nature are incited to certain *Passions*, some to one, and some to another; some are prone to *Anger*, and fly into *Rage* upon every slight occasion; others are of a disposition that inclines them to *Sadness*; others are addicted to *Joy*, *Fear* and the like.

The diversity of these *Passions* proceeds from the contexture of the *Fibres*, and the different *habitude* of the *Humours*. Forasmuch as *Choler* incites to *Anger*, *Melancholy* to *Sadness*; *Blood* bounding to *Joy*. In regard *Choler* vellicates the *Fibres*, *Melancholy* compresses them; *Blood* dilates them, *Phlegm* obstructs them. Which effects we find certain both *sleeping* and *Waking*. Those in whom *Choler* abounds, think of nothing but *Firebrands*, *Burnings*, *Fights* and *Brawls*. The *Sanguine* mind *Dancing*, *Musick*, *Laughter*, *Sport*, and all that tend to *Lasciviousness*. The *Phlegmatick Fancy watry Places*, and *overflowings* of *Rivers*; and so of the rest according as they abound in *Humours*, or have their *Spirits* disturbed.

ADVERTISEMENT.

THERE are some things taken notice of in this HISTORY *of* NATURE, *which probably may seem impossible to some*; *But the* Author *Mr.* LE GRAND *is ready to justifie the same, as well from* Authentick Authors, *as from* Natural Causes, *to such as shall be dissatisfied therein. And the same being* Printed *in all the* Latin Impressions, *and so well received, there is little room left for any real Dispute.*

A

To the Honoured

Sir Henry Hobart

OF

Blickling in *Norfolk*, Knight and Baronet.

Sir,

THE Authors *Opinion in relation to* Brute Animals, *as diſcourſed of in this enſuing* Tract, *being an* Opinion *not commonly received; requires the* Protection *and* Patronage *of ſome* Perſon, *Eminent for his* Learning, *and one whoſe high* Reputation *may* defend *the* Opinion *againſt the* cavelling Critick, *and* wrangling Diſputant. *For this* Reaſon, *Sir, 'tis that I have ſelected You from amidſt the number of thoſe Ingenious* Perſons, *I have the honour of knowing, as reaſonably believing, You who are allowed by all that are ſo happy to be* acquainted *with You, to be excelling in the ingenious performance of* Learning, *may, by Your favouring that* Opinion, *if not totally recommend it as an uncontroverted Poſition, yet* ſtamp *it ſo, as to make it* currant with the Ingenious: *For which Kindneſs and Generoſity I might* bluſh, *ſhould I not gratefully make my* acknowledgment; aſſuring *You that none would more willingly ſerve You to the height of his Power, than,*

Sir,

Your moſt Humble and Devoted Servant,

Richard Blome.

QUÆ SUPRA
To the Honourd S.r Henry Hobart of Blick-
ling in the County of Norfolk Knight and Baronet.
This Plate with the Discours of y.e want of Sens & Know-
ledg in Brute Anemalls, is most humbly Dedicated by Ric. Blome
Lens. Inv.
I. Kip Sculp.

THE THIRD PART.

A DISSERTATION Of the want of SENSE AND KNOWLEDGE IN BRUTES.

I. *What it is that moves some Philosophers to believe that Beasts have knowledge.*

SO far hath the Opinion concerning the *Knowledge* of BRUTE ANIMALS prevailed amongst *Men*, and so infixt hath it been in their *Minds*, that they who dare think otherwise, and refuse to patronise a *Cause* which to them appears so clear, can hardly escape the censure of *Folly* and *Temerity*. In this *Opinion* almost all *Philosophers* agree, and whether induc'd by the industry and vivacity of *Sense*, which they observe some *Beasts* to be indued with, or fancying that they see some *Idea's* of *Reason* in them, they make no scruple to attribute *Knowledge* and *Ratiocination* to them, and pronounce them capable of those *perceptions* and *apprehensions*, which in reality distinguish *human kind* from all other *Creatures*, not being able to imagin how without the help of *Reason*, BRUTE ANIMALS should bring such wonderful *things* to pass, and discover in their *actings* such a world of *Ingenuity*; as for example, how BEES, if void of *Knowledge*, should build so *Geometrically* their sexangular *Cells*, and fill them so exactly at their certain times with *Hony*. What, say they, can these *Creatures* Act so regularly, Consult so deliberately, make Choice so prudently of their *Kings* and *Captains*, and send out so seasonably their *Scouts* to watch and bring in a supply of *Provisions*, and not at the same time give an evident proof of a *Rational Knowledge*; since in all these Performances they cannot be supposed to be carried on by a blind and unaccountable impulse of *Nature*. For what impulse of *Nature* or *Corporeal Energy* can be capable to inspire a meer living and moving *Machine* with *Sense*, and apprehension enough to constitute a *King*, obey his *Commands*, give him their *presence*, *attendance* and *assistance* upon all occasions? How comes that band of *Souldiers* appointed for his Gard? How comes it that one more than another performs this *Satellitory Office*? Is it likely that by meer chance *Serjeants* and *Officers* should be choſen for his preservation, and sometimes to bear him up, when weary, upon their *Shoulders*? If destitute of *Reason*, they are totally ignorant of what they do in all these *performances*: Yet let us further inquire how the *Living* of them should carry out their *Dead*, and after the manner of *Mourners* accompany their *Exequies*? Certainly it must needs be very absurd, not to attribute to *Reason* so many plain *signs* and *evidences* of *Reason*, and after the discovery of such effects, not to find out the latent Cause.

II. *The Industry of Spiders, implies a supposal of Reason, latent in them.*

No less discoveries the SPIDERS make of their Industry and Ingenuity in the curious *weaving* of their *Webs*, and hanging them loose in *Doors* and open *Passages*, wherein is likewise observable the manner of their lying in wait for *Flies*: For why should they place their selves to lie upon the *watch* rather in the center than in the extremities of the *Web*, but that they are sensible of the equality of the *Lines* drawn from the *Center*; and like skilful *Fowlers* understand that the *Net* is more easily drawn in that place. Moreover, if we well observe the ingenuity of certain other *Animals*, we shall find in them no weaker *evidences* of *Ratiocination*, than in those already mentioned. What providential care and forecast is to be seen in the GEESE of *Cilicia*, who conscious to themselves of their garrulous *Nature* when they pass the *Mountain Taurus*, for fear of the *Eagles*, take each a *Pebble Stone* in their Bills, by which means they are forc'd to silence, and do not give notice to the *Enemy* of their coming. Moreover, who can but admire the Industry and Art of the ANTS, who build their *Cities* with so much design and regularity, that the

several *Offices* in them, may easily be discerned, some for holding their *Assemblies*, some for laying up their *Provisions* against the following *year*, and some for the *burying* their *Dead*. *Aldrovandus* was an Eye-witness of a *City* of a *Quadrangular form*, four foot broad, in which the *Ants* were seen to run to and fro through their several *Paths* in great diligence, as it were about their earnest *affairs*. It was exactly drawn in streight *Lines* and *Angles*, and the length thereof was just divided in the midst by a streight Path of a Fingers depth and breadth, through which ran three other ways directly, intersecting it at equal distance one from the other, and of the same depth and breadth. In the extream *Angles* of these ways, as it were at so many *Streets ends*, their *Eggs* were laid up together in heaps. In another part of the *City* were *Granaries* filled up with *Grains* of *Wheat*, so full that the *Paths* were strewed with the overplus, but else all the ways were kept very clean: Lastly, one only Gate there was at the end of the *Cities* length which looked toward the *West*.

These and the like things reported of these *Animals*, do more than enough evince the *Natural Knowledge* they are endued with, and are sufficient to force a Confession from the most Refractory.

III. *The Souls of Brutes, as some of the Ancients are of Opinion, differ not from ours.*

By these Reasons the *Ancients* were induced to believe the *Souls* of *Brutes* were *incorporeal*, and no way differing from those by which the *Bodies* of *Men* are *animated*; or if there were any difference between them, that it did not consist in the *Essence*, but was caused by certain *accidents*; or by the several degrees of *perfection*. Hence that passage in GALEN about the beginning of his *Exhortations: Whether those Animals, which are commonly called Brutes, be totally void of Reason, is not yet sufficiently made out to us; for tho' perhaps they have not that Reason common with us, which is called* Enuntiation *or* Vocal Expression, *yet they have that Reason common with us which belongs to the Soul*, that is, a Reason capable of Affections, tho' some more, some less.

IV. *And are also affirmed by them to be parts of the Universal Soul of the World.*

Very much inclinable to this Opinion were *Plato* and *Pythagoras*, by the Testimony of *Laertius*; and *Thales*, by that of *Plutarch*; and almost all those who gloried in the Learning and Authority of those great *Philosophers*: Forasmuch as supposing that there is one *Universal Soul*, by which *Plants* have their *Vegetation*, *Brutes* their *Nourishment*, and *Men* their *Form* and *Understanding*: They thence infer, that the *Souls* as well of *Brutes* as *Men*, are parts of this *General Soul*, and that they all arise and spring from the manifold division thereof.

Upon the confidence of this Opinion, *Thales* took the boldness to affirm, *that all things are full of Divinity*; consequently that there is no *Body* existent, which hath not its particular *Dæmon*; and so compriseth in it self something of *Divine*. Blinded also by this conceit, the *Disciples* of PLATO asserted that the *Souls* both of *Men*, and all other *Creatures* are equally *mortal* and void of all *corruption:* For since they are active and move themselves by their own proper *Force*, they cannot by any *external Agent* be urged to Rest, for that must of necessity perpetually *exist* which depends not upon another, and borrows not the permanency of its duration from any.

V. *This Opinion of theirs admitted, there will be no difference between Brutes and Men.*

But this *Opinion* hath long since grown out of date, and is reckned by the *Fathers* among *Plato's Childish Fictions*, so that there is no necessity of encountring them with *Arguments*: Let it suffice to take notice what enormous absurdities must needs arise from the admitting of this *Opinion*, and what confusion in Nature would follow: For if the *Souls* of *Beasts* be *eternal* and invested with *immortality*, what distinction will there be between *Men* and other *Animals*? Doth the same felicity attend them as us? However, not to be over sollicitous about the beatitude of *Beasts*, let us at least examine where those *Souls* are disposed, which have been existent from the beginning of the *World*; what *Places* are allotted for them? Whether they have any peculiar *Elysian Fields* assigned them to wander and exspatiate in? What is become of all the *Gnats* and *Flies* with which the *Ægyptians* were heretofore disturbed? What was their business after *Death*? And to what end were they kept? Or what advantage accrewed from their *Death*; when it must be confest by all *Men*, that *God* governs all things by his wonderful Wisdom, and directs all *Creatures* to a certain end. All these things considered, it is most consentaneous to Reason, that the *Souls* of *Brutes* return to the *Earth* from whence they had their first beginning, and cease to *live*, when they cease to be among us.

VI. *The Order of things to be said in the First Part of this Dissertation*

But not to wander too far in the very entrance of this *Discourse*, let us come to the purpose, and examine whether *Animals* are indued with a *Real Knowledge*, or can judge or reason of *things* that are without them; which that we may the more easily compass, it will be worth our while in the First Part of this Discourse to inquire, First, what the *Soul* is, and what sort of *Soul* is proper to *Brute Animals*. Next what *Knowledge* is, and wherein the formal Reason thereof consists. Lastly whether *Beasts* perceive, and what Principle guides them in all their *Actions*.

VII. *Aristotles definition of a Soul, vain and frivolous.*

To begin with that which in the first place was proposed, it will be of great consequence to know what the *Soul* is, and what is imported by that Vulgar Name; for when *Men* first imposed *Names* upon things, before they well understood their *Natures*, and enquir'd into the Properties of each distinct one from the other, it followed of consequence, that the name of *Soul* was indifferently attributed to all *Living Creatures*; and as well *Plants* and *Trees*, as *Men*, and all other *Living Creatures* were said to be indued with *Souls*. But in this affair no Man erred more than *Aristotle*; forasmuch as going to define the *Soul* in general Terms, this cunning *Philosopher* took great care that he might not be carpt at by Posterity, and thereupon brought forth such a definition of a *Soul* as might be applied almost to all things, and so serve as a common *Plaister* for the *healing* of all *Sores*. For in his Second Book *De Anima*, going about to explain the *Essence* of the *Soul*, he defines it thus. *A Perfection or Act of a Natural Organick Body, potentially endued with Life.* But how wild a *definition* this is, may be hence collected, namely, for that *Divines*, *Physitians*, and others, do all make use of it alike, and in so doing, appropriate it to things of a quite different Nature.

Nature. For *Theologists* and *Interpreters* of *Holy Writ* assert, that the *Soul* of *Brutes* is the *Blood* or *Spirit* exhaling from the *Blood*. To make this good, *Aristotle* is presently at hand, and suggests that the *Blood* is the Act of a *Natural Organick Body*, having Life potentially. The *Physitians* are pleased to make the *Soul* a temperament of the *Body*, and a harmony of the *Humours* which abound therein. This according to *Aristotle* must be that *Act* of an *Organick Body* which hath *Life* potentially in it. Antient *Philosophers* maintain that the Air is the *Soul*, taken in at the *Mouth*, cooled in the *Lungs*, and diffused into the *Body*; this comes up in conclusion with *Aristotles definition* of a *Soul*, since he also defines *Air* to be the perfection of a *Natural Body*, potentially indued with *Life*. Others suppose the *Soul* to consist in *heat*, or at least that it is a *subtile Spirit*, which gives *sense* and *motion* to the *Body*; this *Aristotle* doth not wholly gainsay, yet withall obstinately maintains that this sort of *heat* or *Spirit* is nothing else but the *Act of a Natural Organick Body*, having *Life* potentially in it, so that whatsoever shall be alledged, or fancied concerning the *Soul*, tho' never so obscure, must be comprehended under this definition, and will challenge to it self both the *Genus* and *Difference*.

VIII. *Nay obscure, and explaining nothing distinctly.*

But tho' this *definition* did not dilate it self so far, and were only confined to certain *things*, yet were it not fit to be retained among *Philosophers*; for what is there in it, that ought not to be rejected, it containing in it no absolute *attribute* which can any way explicate the *essence* of a *Soul*; nor do things only respectively and generally predicated, and which may be mixt, and as it were link'd with other things, produce any more than a confused *Knowledge*. Besides, what is there distinct, that can be made intelligible to us by the word *Act*, no more indeed than if any one should define *Light* to be the *Act* of a *Lucid Body*, or *Heat* the *Act* of a *Calid Body*; which *definitions* are so far from rendring us any whit more wise than before, that they serve only to involve us in an inextricable *Labyrinth*, and by a strange ambages of *words* render that obscure which was far more clear of it self. In so much that HERMOLAUS BARBARUS, a Learned Man, and for his great *Wit* and *Parts* very eminent among those of his Profession, when he had ambitiously sought, and at length obtained a Meeting with a *Dæmon*, is said to have requested of him no greater matter than to be resolved in the signification of the word *Actus*, in the foresaid definition of *Aristotle*, that so he might approve himself a worthy *Disciple* of so great a *Philosopher*. These things I have the rather added to make it appear what obscurity the Notion of *Soul* would incur, by being divided into *Vegetative*, *Sensitive* and *Rational*; and how little of Light is to be gained from those who make a vast confusion, by comprehending under one and the same distinction, things very different and remote in their own Nature.

IX. *There are only two sorts of things, Material and Spiritual.*

To proceed therefore more accurately as to the *Souls* of *Beasts*, and to the *Knowledge* they are indued with; we are to suppose from the *Institution* of *Philosophy*, that there are in *Nature* only two sorts of *things*; one *Intellectual* or *Thinking*, the other *Material* or *Corporeal*. Under the first are comprehended MINDS and SPIRITS; under the latter all BODIES, which are vulgarly named *Natural*. Nothing can gainsay, but that *Man* is partaker of both *Natures*, and possesseth at once both *Cogitation* and *Extension*: Forasmuch as *Man* is not a thing simple and of one kind, but composite, and as it were a Medium, including both extremes; so that it is evident that *Brute Animals* are of a different *Nature* from *Man*, and no way indued with *Mind* or *Spirit*; forasmuch as all *things* which *Beasts* contain, are to be referred to a *Material Principle*, and have nothing of affinity with *Men*, except what refers to *Body*. We must therefore inquire what *Principle* it is in *Beasts*, by which they are not only Nourish'd, Grow, Breathe, are Moved, *&c.* but also by which they operate and perform those wonderful things in which they seem not only to come near the Wit and Subtilty of *Men*, but even to exceed them.

X. *Gassendus his Opinion of the Nature of the Soul of Brutes.*

GASSENDUS an eminent *Philosopher* amongst the Moderns, and so much the more praise-worthy, for that he hath refined and given new light to the *Opinions* of the *Antients*, imagins the *Sensitive Soul* of *Brutes*, (and a more than *Sensitive Soul* no Man that I know will allow them) to be a sort of *Flame* or *Species* of most subtile *Fire* which infuses *Life* into the *Animal*, and actuates and performs all its parts; so that the *Animal* lives so long as this little Flame continues in vigor, and dies when it is extinguished. For tho' this *Fire* be a *Body*, yet in respect of its subtilty, it may be reckoned immaterial, if compared to the rest of the *Corporeal Mass*, and may justly for that Reason obtain the name of *Anima* or *Soul*; and the *Animal* thereupon be rightly said to consist of *Body* and *Soul*. Wherefore if the *Essence* of a *Brute* consists in this, that its parts are subtile and continuous, and are agitated by a quick motion, and there be also a continual succession of some parts into the room of others destroyed; in like manner the *Fire* or *Flame* wherewith *Beasts* are animated, is a *Congeries* and contexture of most subtile *Atoms*, which are stirred up by a quick motion, and by a continual *generation* of some, and departure of others, always preserve and maintain the same *Essence*: For into what other *principle* is the *heat* of the *Body* to be referred but to the *Internal Fire*? Whence comes its *motion*? How shall the *Organs* of the *Senses* receive the impressions of *Objects*, unless they be cherish'd by *heat*? And whence that *heat*, but from the *Soul*, which performs and executes all the *functions* of the said *Animal*; for tho' it may well enough be said that the *Soul* may rather be kept from *heat*, than *heat* from the *Soul*; yet it is manifest that *heat* depends upon *motion*, and is not existent in the *Body*, but for that action of an *internal Principle*; so that it must necessarily come to this, that there is a *Material Anima*, as GASSENDUS expresses it, to produce *heat*, give *motion* to the Members, and perform other Acts of the *Animal*.

XI. *That the Soul of Brutes is a Pure Fire, according to* Honoratus Fabri.

Not much differing in Opinion is *Honoratus Fabri* in his Second Book *de Homine*, where he concludes, *That the Soul of Brutes is indeed a Fire, but pure and free from the mixture of other Elements*; to the asserting whereof he is chiefly induc'd, because *Fire* vegetates; and there is most virtue

virtue (as experience tells us) where there is moſt *heat*, and where that ſtronger Element prevails. For whereas in other *ſimple Bodies* there is no footſtep of *action* to be diſcerned, and *Fire* only is powerful by its productive *virtue*, Reaſon evinceth, ſaith *Fabri*, *That if any Element be armed with the force of Senſe, it muſt be allowed rather to Fire, than to any of the reſt:* Not that *Fire* abſolutely taken is inveſted with ſuch a power as to ſupply the place of a *Senſitive Soul*, but ſo far as it is conſtituted in ſuch a frame of the *Organ*, ſuch a diſpoſition of *Parts*, ſuch a Conduct, Communion and Texture of the *Fibres*.

XII. *Carteſius his Opinion that the Soul of Brutes is the Blood.*

The moſt Illuſtrious CARTESIUS, who hath refined *Philoſophy*, and purged it from all its folly and obſcurity, and teacheth nothing but what is highly conſonant to Reaſon, ſuppoſes the *Souls* of *Brutes* to be nothing elſe but the *Blood*, and and that there is no occaſion of a *Senſitive Soul* for the performance of their *operations*, and the production of the faculty of *moving*, and being *ſenſible*; for this moſt Sagacious *Perſon*, when he conſidered the *Blood* to be a *fluid Body*, and that the more ſubtile part thereof is carried by a continual circuit from the *Arteries* into the *Brain*, thence into the *Nerves* and *Muſcles*, doubted not to aſſert that the *Blood* heated in the *Heart*, and attenuated into *Spirit*, conſtitutes the *Soul* of *Brutes*; and that from its motion alone, their various *motions* do proceed. This *Opinion* ſeveral places of *Holy Writ* ſeem to favour, and vindicate from the pertinacie of certain Detractors, who will needs take upon them, that it paves a way to *Atheiſts*, and gives them incouragement to think the ſame of *Men*, and conſequently to divorce the *Rational Soul* from the *Human Body*; when as indeed ſo great is the diſtinction between the *Souls* of *Men* and other *Animals*, and ſo great the difference between the operations of the one and the other, that it can hardly be doubted, even by the moſt ſtupid of all *Mankind*, but that they ariſe from different *Principles*.

XIII. *The Life of Animals conſiſts in the continual motion of the Blood.*

Be it granted then, that the *Life* of *Animals* conſiſts in the inceſſant *motion* of the *Blood*, which beginning its courſe from the right *Ventricle* of the *Heart*, paſſes through the *Vena Arterioſa* into the *Lungs*, whence flowing into the left *Ventricle* of the *Heart*, it paſſeth into the *Aorta* or great *Artery*, whoſe Branches are diſpers'd through the whole *Body*, and being joined to the Branches of the *Vena Cava*, convey the ſame *Blood* again into right ſide of the *Heart*; ſo that the *Blood* heated in the *Heart*, and converted into *Spirits*, obtains the name of *Vegetative* and *Senſitive Soul* in *Animals*, and is the immediate and principal *Organ* of all *Actions*, as may be apparently diſcovered in certain *Animals*; for examples, in *Flies*, *Serpents*, *Scorpions*, *Frogs*, &c, which through the extremity of cold in the *Winter*, lie void of *ſenſe* and *motion*; and for the time in all appearance, totally deprived of *Life*, that is, while the *Blood* ceaſes to be in agitation, and the *generation* of *Spirits* is for the preſent ſtopt; which *Animals*, when the *Genial Spring*, as *Mantuan* expreſſeth it, gives new *principia* to things, the *motion* of the *Blood* being renewed by *heat*, are again raiſed to *Life*, and reſume their long intermitted *functions*. The ſame thing may be ſeen in *Men* who are *hanged* or *drowned*, foraſmuch as in a very ſhort time they expire, by reaſon that the *Blood* ſtagnates for want of *reſpiration*, there being no paſſages open from the right *Ventricle* of the *Heart* into the left. The *Blood* therefore muſt needs be the principal part of *Animals*, from whence the native *Heat* and *Spirits* flow, and from which to thoſe that are born, *Life* firſt begins, and to thoſe that *Die*, laſt ends.

XIV. *How it ought to be underſtood that Beaſts have no Soul.*

Altho' in explaining the *functions* of *Beaſts*, we make no mention of their *Soul*; yet at the ſame time we deny them not *Life* nor *Sentiment*, provided always that by *Life* and *Sentiment* of *Animals*, no other thing is to be underſtood, but the *heat* of their *Blood*, and the particular *motions* of their *Organs* of *Senſe* which depend thereupon: Nor is this more unreaſonable, than to attribute to *Beaſts* a *Soul*, which ſhould be really diſtinct from the *Body*, and which nevertheleſs cannot ſubſiſt without the *Body*, it being the ſame thing as to ſay, that the *Soul* of a *Beaſt* is at one and the ſame time a *Subſtance* and a *Mode*; a *Subſtance* by ſuppoſition, and a *Mode* as having need of a ſubject for its exiſtence.

XV. *What Cognition is, and wherein its Nature conſiſteth.*

Now it being made out, that the *Blood* overflowing the whole *Body*, and having by iterated turns a continual orbicular rotation to the *Heart*, from whence it had its firſt ſource, is the real *Soul* of *Brutes*, we muſt paſs on to the Second Foundation, as it may be called, namely, what we are to apprehend by that which is commonly called their *Cognition* or *Knowledge*, what it is that conſtitutes their *Ingenuity*, and into what ſpecies chiefly it is to be diſtributed. The *Idea* of *Cognition* is ſo manifeſt, that there is ſcarce any thing which occurs to our Mind, which is more certainly known; and if by chance any perſons in the explaining thereof have erred, I conceive the occaſion thereof hath been, for that they have by their crabbed Terms, rendred that obſcure, which of it ſelf was ſufficiently plain; and were minded, as they ſay, to hold a *Torch* to the *Sun*: For in this very thing, I find that all *Philoſophers* have very oftentimes made great miſtakes, namely, in indeavouring by *Logical Definitions* to explicate the moſt ordinary and ſimple *matters*, tho' in their own Nature intelligible; and by certain circumlocutions of *words* to go about to render thoſe things perſpicuous, which voluntarily offer themſelves to our *underſtanding*; for what Object can preſent it ſelf more clearly to us than *Cognition*, when as, if I perceive any thing, I ſeem to have its *Image* or *Idea* before me, and to behold it as it were preſent, with the *Eyes* of my *Mind*. For tho' perchance I be doubtful of all things exiſting in Nature, and may call in queſtion what I *touch* with my *Hands*, *ſee* with my *Eyes*, *hear* with my *Ears*, *ſmell* with my *Noſe*, or *taſte* with my *Tongue*; yet all this I cannot chooſe but *think*, and my very dubitation is a certain *thinking*, which I cannot but be ſenſible of.

XVI. *Every Cognition includes a Conſciouſneſs.*

Wherefore by the name of *Cognition* we are to underſtand all that which ſo proceeds from us, that we are immediately conſcious to our ſelves thereof. So that to *think* or *know*, is nothing elſe but to have a perception of thoſe *things* which are in us. But to make the matter more plain by an *Example*, How doth any one know that he is indued with a faculty of *Underſtanding*, *Willing*, *Affirming* or *Denying*? but becauſe he experimen-

riments in himself this sort of *Faculty*, and is conscious to himself of such a power so long as he exerciseth it. But this is not to be understood of *Reflex Cognition* only, that is to say, by which any one perceives or observes that he hath observed any thing, but also of any primary *Perception* or *Intellection* whatsoever, by which he gives attention to any thing. Whence it follows, that if one have not a *consciousness* to himself of those things which he acts or suffers, he experiments in himself no knowledge of them, and thereupon may be said to be destitute of *Sense* and *Cognition*, properly so called: For how can the Sense of *Action* or *Passion* be attributed to him, if he knows not that he *Acts* or *Suffers*? Hence it comes to pass, that if *Men* attentively fix'd upon any thing are so taken up in contemplation, that they perceive not a *Torch* lighted before their *Eyes*, they cannot indeed be said to have any sense or perception of those things. And therefore that they may be said to be *sensible*, to *perceive*, *judge*, *affirm*, *deny*, &c. they must needs be knowing of those things which they are sensible of, perceive, judge, *&c.*

XVII. *Cognition is divided into four Kinds.*

All *Cogitations* which include *Consciousness*, are most especially two fold, *Actions* and *Passions*. All species of *Perceptions* or *Cognitions*, which are found in us, or which proceed from the power we have of perceiving or knowing, are called *Passions*; and all such *Operations* are divided into four kinds, the first is *Intellect*, by which the *Mind* without the help of any *Corporeal Species* perceives all manner of *Objects*, as well immaterial as material: The second is *Sense*, as well that which is external, as internal: The third is *Imagination*, containing under it common Sense; forasmuch as they are both actuated by the same *Organ*, and are imployed about the same *Objects*: The fourth is *Memory* or *Reminiscence*, being that faculty by which we deprehend that we had formerly the same *Cogitation*. Those *Cogitations* which are called *Actions*, are all our *Wills*, because we find them to proceed directly from our *Soul*, of which alone they seem to depend; and to these are to be referred all our *Judgments*, *Inclinations*, *Appetites*, and all the *Motions* of our *Will*, which always accompany the power of our Willing and determining.

XVIII. *How Corporeal Matter differs from Immaterial and Incorporeal.*

These *things* being thus explained, as far as the brevity of our Subject would permit, and premised as the foundation of our *Discourse*; We come now to examin whether the *Cognition* above-mentioned and defined be to be attributed to *Brute Animals*, or to speak in more expres Terms, whether *Beasts perceive*, are *sensible*, *imagin*, *remember*, &c. and whether they imitate *Men* in these *Operations*, so far as to carry in them any semblance of *Reason*; which to make out the more clearly, we are to call to mind, that the Nature of *Corporeal Matter* consists precisely in this, that it contains *Longitude*, *Latitude* and *Profundity*, or that it is a *Matter Extensive*; for to consist of these three dimensions, is no other thing than to be extended, and to be extended is no other than to be capable of those three *proprieties*: To *Body* or *Matter* the *Spiritual* Part is *diametrically* opposite, whose *Nature* consists in *Cogitation*, and which admits of no dimension, either *Longitude*, *Latitude* or *Profundity*; for all that is known to be in a *Spiritual Essence* is, that it is a *thinking thing*, that is, *Perceiving*, *Affirming*, *Denying*, *Willing*, *Nilling*, &c. All which are understood without any *Idea* of Extension, and have no affinity with *Divisibility*, *Figure*, *Situation*, or any other *Affections* of the *Body*; and thence we must conclude, that *Cogitation* is an *Attribute* of a *Substance* containing no *Extension*; and on the contrary that *Extension* is an *Attribute* of a *Substance* admitting of no *Cogitation*: For those two *Idea's* are utterly different, and represent to our *Mind* nothing that is any way alike. What conduces more to the evidence of one thing being distinguish'd from another, than that one may be conceived without the other? For if we rightly infer that those *Bodies* which are not *square*, may be of *Sphærical Figure*, and that those which are least capable of *motion*, are *square*, since *Imagination* can soon distinguish *quadrature* from *rotundity*, and ascertain that it is the nature of a *square Body*, to be least apt for *motion*; may not the same Reason serve to conclude, that there may be certain *Substances* void of *Extension*, because the *Idea* which we form to our selves of *Extension*, differs from the notion of *Cogitation*? Forasmuch as to establish a difference beween two things, it sufficeth that one may be distinctly perceived without the other.

XIX. *Whatsoever the Soul of Brutes is fancied to be, it is void of Cognition.*

From this *Principle* then being granted, it is most clearly to be inferred, that *Brute Animals* are not only incapable of *Cogitation*, but are also void of every simple *Perception*: For whatsoever sort of *Soul* may be fancied to be in them, whether *Blood* circumfused through the whole *Body*, as the Noble CARTESIUS maintains, or a pure *Fire* or *Flame*, as FABRI and GASSENDUS will have it; giving *Life* and *Spirit* to all the parts thereof; we must of necessity admit that this sort of *Soul* is *Corporeal*, and contains not any thing alien from the nature of *matter*; forasmuch as tho' *Blood* rarified in the *Heart*, should evaporate into *Animal Spirits*, which like a most subtile *Wind*, ascend up into the *Brain*, and are conveyed through the *Nerves* into the *Muscles*; and tho' this *Flammula* be composed of the most subtile parts, and emerging as it were out of the grosser Mass, may seem to emulate the agility, as I may so say, of *Spiritual Things*, yet nevertheless it doth not for all this cease to be material; nor do those accidental qualities advance it above the condition of a *Body*: So that if *Cogitation* be denied to *Matter*, and a thing extended be not in a capacity to be conscious of that which happens to it, that very thing will be against materiality, tho' never so subtile, and diffusing it self through any whole *Body*: For the tenuity of *Parts* takes not away the Being of the *Matter*; and whatsoever is capable of being extended, that Capacity is sufficient to give it the name of *Matter*, and to invest it with, and make it partaker of its imbecility: Who can say that that subtile *Matter* which enters the *Pores* of *Gold*, *Adamant*, *Steel*, or whatsoever other solid *Body*, is of a nature different from *Body*? *Accidents* change not the *Essence* of things, and the subject must of necessity remain always the same as to *Essential Proprieties*, let it be changed never so much, or undergo never so many new *Denominations*.

XX. *Body is incapable of Cognition.*

What is it that can conduce to the making up of a *Body*? All that we conceive of it, is that it may be touch'd, remov'd, and have its *Figure*

alter'd, and that it may upon occasion take in, and give back *heat*; that it is *dry* or *moist*, that it gives a *sound* when it is *struck*, or else *deads* the *sound*, that it may *increase* or be *diminish'd* divers ways; and thus you have all that can happen to a *Body*: But what signifies all this to *Perception* and *Cognition*? Certainly to be *Touch'd*, *remov'd*, *Chang'd* in *Figure* or *Shape*, or be heated is quite another thing, from to perceive. Take a piece of *Wax*, give it what *Figure* or *Posture* you please, or let what *Impression* you think fit be made upon it by the most excellent *Engraver* in the *World*; turn it which way you please, shake it, move it up and down with never so much violence, put it into all forms or postures Imaginable, be sure the *Wax* will never complain of any of these ill treatments, or give the least thanks for any of the fine *Figures* impress upon it; since all this is done without the least *Cognition* thereof in the matter so handled.

XXI. *Nothing of Body can have perception.*

All this that hath been said of the *Wax*, is also to be said of any other sort of *Body* imaginable: For any one may very well think that *Wax* cannot perceive all these mutations, in regard it is not *animated*; but that if it had a *Soul* like to that of *Animals*, then surely this *Soul* would without any difficulty perceive whatever could happen in the *body* of the *Wax*; but all this comes not up to the purpose: For if this *Soul* of the *Wax* or of *Animals* were a *Spiritual Substance* like ours, I conceive it would have the faculty of knowing and perceiving the *motions* of any other *Body* near it, or intirely present: But if the *Soul* of the *Wax*, like that of *Beasts*, be a *Corporal Substance*, that is to say, be *Body* it self, one may say of that as of the *Wax*, that it may be moulded into divers *shapes*, that it may receive a world of *Figures*, that it may be capable of *cold* and *heat*, and such like qualities; but that all this together will not be sufficient to cause it to *perceive*.

XXII. *Whether Matter be the Cause of its own Motion.*

Now let us go a little back, and fetch our *Argument* more from the Root of the Business, and shew that *Matter* or *Body* is not only not capable of Perception, but also not so much as of producing its own *motion*; for as we have demonstrated in our *General Physicks*, GOD is the *Primary* and total Cause of all *motion* in the *World*, and consequently a *Body* cannot give it self any *motion* whatever.

XXIII. *Matter is passive and incapable of all Action.*

I am not ignorant that some *Philosophers* will oppose this *Argument*, and not suffer *Matter* to be so undervalued, as to be reputed altogether sluggish, and totally alien from all *Action*; how can it concur, say they, to the constituting of a *Compound Body*, if it be meerly passive, and have no other *motion*, but from without? Do not we see the *Atoms* in our *Sublunary Region* to be moved, and spontaneously carried to and fro? Whence proceeds this impulse? What is the cause of this continual agitation? What but a certain inbred Power of *matter*, by which it determinates it self to *motion*, and according as occasion requires, agitates and winds it self? Who can deny but that the *Heavy Bodies* descend of their own accord? That a *Bent Bow*, when the obstacle is removed, springs back, and returns to its pristin State? But what invisible Agent is it that here interposeth, and comes to restore a bent *Stick* to its former place? If therefore *Matter* be capable of *action*, and hath in it self a power of agitating, and moving to and fro; what should hinder but that it may obtain a power of perceiving, and by a certain impression of the Great *Creator*, being furnish'd with certain *Organs* fitted for that purpose, may *think*, *apprehend*, *imagin*, *remember* and *exercise* all other functions of an Intelligent Nature?

XXIV. *Matter is only Potential, not Action.*

I am sufficiently assured that I have comprehended in brief whatever can be alledged against the inactivity of *Matter*: So that I have nothing more to do but to invalidate these *Reasons*, and to make good that *Matter* is only an *Unactive Mass*, and no less uncapable of *Motion* than of *Cognition*. All *Philosophers* that know any thing of the *Nature* of *Matter*, know that it is only *potential*, and that it differs chiefly in this from an *Intellectual Thing*, namely, that this last is *Actual*, the other *Potential* only, that is to say, if the *thing* be well understood, that it is only a dead sluggish Lump, and void of all Activity. For this is the difference between a *thinking* and an *extended Substance*, namely, that *Cogitation* is always present to the *mind*; whereas *Motion* is never contingent but to a *Body*, and that while it is impelled by an *External Agent*, and borrows the power of moving another *Body*.

XXV. *Aristotle's Authority to prove that Matter is slothful.*

But because *Aristotle*'s authority hath been always held in high esteem, and all *things* that have been quoted or excerpted from his *Writings*, lookt upon as *Oracle*; it will not a little conduce to the establishing of our assertion to declare the said *Philosophers Opinion* in this matter: And first in his Book of *Generation* and *Corruption*, he acknowledges the *Matter* is bare of it self, and only *passive*, unless some *External Agent* intervenes which actuates it, and from which taking impression it cannot be hindred from both moving it self, and exciting to *motion* some other *Body*: Also moreover in the same *Book* he affirms, in several places, that to suffer, and to be moved, are proper to *Matter*; but that to move and to actuate are from a power without: Also in the Third Chapter of his First Book of *Metaphysicks*, where he more exactly inquires into the Original Cause of *Motion*, he sharply reproves the *Antients*, for that in their *Physicks* they considered *Matter* only, neglecting at the same time the Primary Principle of *Motion*; and in his *Meteorologies*, explaining his Opinion more clearly, he affirms that neither *Form* nor *Motion* do belong to *Matter*; but only so far as they are impress from without. Nor will it suffice to answer, that *Aristotle* spoke here only of *Matter* in common; forasmuch as he absolutely makes his Discourse of Particular *Bodies* indued with a certain *Figure*, which generally in *Physicks* are called *Bodies Natural*; and in expres *words* and *terms* labours to demonstrate, that no *Natural Body* hath a *motion* from it self, and that *Animals* themselves which seem to be spontaneously moved, are indeed moved with an external *Agent*: For when in the Second Chapter of his Eighth Book of *Physicks*, he makes to himself this Vulgar Objection, that an *Animal* at first lying still and motionless, afterwards visibly appears to *move* and *walk*, without any appearance of any external Movent: The said *Philosopher* presently replies, that this is false; for we see, saith he, something of those *things* which are innate to the *Animal*, to be always in *motion*, but that of this

motion

motion not the *Animal* it ſelf is the *Cauſe*, but moſt probably the circumambient *Air*.

XXVI. *An Explication how Atoms in the Air are moved, and how a bent Bow ſprings back.*

From which places it evidently appears that ARISTOTLE thought *Matter* to be a Principle purely *Paſſive*, that it was from an *External Cauſe*, both that it was moved it ſelf, and that it had power of moving any other *Body*; notwithſtanding what is alledged of *Atoms* flying about in the *Air*, and of the Action they manifeſt by paſſing from one place to another: Foraſmuch as the ſaid *motion* is not to be imputed to the *Atoms* themſelves, but to a certain *Subtile Matter*, which in our *Inſtitution* of *Philoſophy* we have made mention of, as being in continual *motion*, and entring and piercing into the *pores* of all *Bodies*; and ſince it is not to be doubted but that a vaſt quantity of this *Subtile Matter* is contain'd and diſpers'd throughout in the *Air*, no wonder if ſuch ſmall and ſlender *Bodies* as *Atoms*, proceeding from neighbouring *Bodies*, are agitated up and down according to the various motions of the ſaid *Subtile Matter*. By the ſame Reaſon is the experiment of the *Bended Bow* to be reſolved, in regard that *Elaſtick Force* by which a *Bow* flies back to its former ſtate, is not to be referr'd to the very matter of the *Bow*, but to the *Æther*, that ſubtileſt of *Bodies*, which entring through the more open Pores of the *ſuperficies*, and finding them ſtreighter and ſtreighter as they are more and more inward, forcibly urges its way, and makes a kind of an attempt to looſen thoſe ſtreightned *pores*, by a drawing together of the extremities, ſo to make its paſſage the freer.

XXVII. *The Subtile Matter borrows the force of its activity from the firſt Mover.*

Now if it be demanded, upon what account then do we deny *motion* to *Matter*, if this moſt ſubtile *Æther* we ſpeak of, be not only moved it ſelf, but alſo have a power of moving, penetrating and impelling other *Bodies*? Hold a little, good Inquirer, and take notice, we do not allow this moſt *Subtile Matter* to be the Principle of its own *motion*, but the firſt Mover, namely GOD, who from the firſt inſtant of *Created Matter* imparted a various *motion* to its parts: And by the ſame *Action* by which he conſerves *Matter*, retains in the *World* altogether the ſame quantity of impreſſed *motion*, and preſerves it intire.

XXVIII. *There is no intrinſecal gravity in Bodies.*

No more can the activity of *Matter* be any better defended by the objected *gravity* of *Bodies*, ſince it is an abſurd thing to imagin that there is inbred gravity in *Terreſtrial Bodies*, by which they are carried downward to the *Earth*, or have an inclination to be ſo carried; for thus to imagin what is it elſe, but to impute *Intellect* or *Underſtanding*, to *things* meerly paſſive, and to attribute to them the *Actions* of the *Will*? For in truth, there is nothing elſe to be underſtood by Gravity, but that the *Subtile Matter* interpoſed between us and the *Orb* of the *Moon*, and by a moſt ſwift *motion* roll'd about the *Maſs* of the *Earth*, drives all *Bodies* towards the *Center*, and denies them any abode in the *Higher Regions*; ſo that could the force of this moſt fluid *Liquor* be taken away or removed; no *Body* would be heavy, and a *Stone* placed in the middle of the *Air*, would hang there and remain in that ſuſpended poſture, and never ſlide downward, unleſs that ſubtile *Agent* were at hand to drive it down towards the *Earth*: No Body therefore is mov'd by it ſelf, but muſt be ſaid rather to Suffer than to Act, till ſuch time as it is forced to remove from place to place.

XXIX. *Parts in Matter, whether Homogeneous or Heterogeneous, cannot move themſelves.*

This alſo will appear more plainly, if we conſider the parts of which a *Material Subſtance* conſiſts; whether they be *Homogeneous* or *Heterogeneous*: For if they be ſuppoſed to be *Homogeneous*, and to be all moved immediately by themſelves; in all probability they could never reſt, or be ſo compact one with another, as to keep together, and compoſe thoſe Bodies which daily appear to our *Eyes*; becauſe whereas ſuch a *motion* is innate to the parts of *Matter*, and muſt neceſſarily flow from them, they could not poſſibly coaleſce, but would remain diſtinct from each other, and refuſe all conſiſtence: Otherwiſe if they were able to abſtain from that *motion*, and at their pleaſure compoſe themſelves to reſt, what could we do leſs than ſet them free, and acknowledge that things *inanimate* are indued with Counſel and Deliberation? But if the parts of which this *Material Subſtance* is compil'd, be *Heterogeneous*, and ſome of them be active, as GASSENDUS thinks poſſible, and others ſtiff and void of all capacity of *moving*, no leſs confuſion would ariſe in the *World* from this poſition of Parts, than if all Parts were indued with the capacity of *moving*, in regard that when thoſe which are inveſted with this Power, cannot but impel their neighbouring *Parts*, and thoſe ſo impelled cannot lay aſide their borrowed *motion*, unleſs by imparting it to other contiguous and leſs agitated; nor theſe laſt loſe any thing of their celerity, ſince it is inbred in them and unchangeable; it follows that the whole Frame and Machin of the *World* would be immediately ſhattered, not the laſt *particle* thereof ceaſing from *motion*; whence the Famous Dr. MORE in his *Exchiridion Metaphyſicum*, altho' he generally makes it his buſineſs to oppoſe the Doctrin of DESCARTES, yet in this Foundation of *Phyſicks*, he is forc'd to ſubſcribe to his Opinion, whilſt he thus defines a *Body* in general, *a Body*, ſaith he, *is a Material Subſtance altogether of it ſelf deſtitute of Life and all manner of Motion*: Or thus, *Body is a Material Subſtance incorporated into one by an External Power, and by the ſame manner participating Life and Motion*; by which *words* this moſt Eminent Perſon gives to underſtand, that *Matter* of it ſelf is altogether a Slug and void of Action.

XXX. *As Matter is void of Motion, ſo its uncapable of Perception.*

It having been thus demonſtrated, that *Corporeal Things* are not indued with any moving Power, and conſequently that their *motion* muſt proceed from elſewhere: It will be no difficult matter now to evince that they are alſo deſtitute of *Cognition*, and can by no manner of Right aſpire to any kind of *Thought* or *Imagination*. For what affinity can *Extenſion* have with *Perception*? What acquaintance can there be between *Mind* and *Body*, except that both are equally ſubjected to the ſame *Genus* or *Kind*, namely, *Subſtance*, and each of them equally called *Ens per Se*? But it is ſufficiently known among *Logicians*, that the *Species* of any *Supream Genus* do not agree, except in the *Eſſential Attributes* of the ſame kind, otherwiſe they would not deſerve to be called the *Principal Species* thereof; and that higheſt *Genus* would more properly be called an *Interjected Genus*, dividing thoſe *Species* from another *Superiour Genus*. But *Subſtance* is the *Supreme Genus*, and its

its immediate *Species* are *Body* and *Spirit*, so that they cannot agree except in the *Essential Attributes* of *Substance*, such as are *Ens per Se*, *&c.* But of the number of these, neither *Perception* nor *Extension* are to be reckoned, since there are some *Substances* which perceive not, and others which are not extended; so that *Cogitation* and *Extension* belong not to *Substance* in general. Now to proceed a little further; That which appears only in *Essential Attributes*, ought to be differenc'd from all others; but *Mind* and *Body* agree not, except in *Essential Attributes*; therefore *Mind* and *Body* differ from all the rest, and are opposed to them in those things which have not an ingress into the Nature of *Substance*: For it implies a contradiction, that two things should be united in that very particular wherein they differ and contract an association by that wherein their opposition formally consists.

XXXI. *Cogitation cannot belong to Extension, neither as an Essential Part, nor as a Propriety or Mode.*

To this Ratiocination no small light will accrew, if it be demonstrated that *Cogitation* can by no means consist with *Extension*, and that in this manner: If *Perception* may be attributed to *Extension*, it belongs to it as a thing constituting its *Essence*; or as a Propriety which accompanies its *Essence*; or, lastly, as a *Mode* or *Accident* which denominates it: *Cogitation* cannot as an *Essential Attribute*, agree to *Body*, for then it would follow, that all *Bodies* are indued with *Cogitation*, and consequently that not only *Brutes*, but also *Trees*, *Stones*, *Stocks*, &c. are indued with *Cognition*. Not as a Propriety of *Essence*, in regard since Propriety is applicative, *omni*, *soli*, *& semper*, to every of the kind, to that kind alone, and always: It would thence follow, that the *perceptive faculty* would belong to every *material thing*, and there would be no sort of *Body*, tho' never so contemptible, to which *Cogitation* might not be attributed. Lastly, Not as a *Mode* affecting the *Substance*, in regard such is the nature of *Mode*, that tho' a *Subject* may be understood without its *Mode*, yet on the contrary, *Mode* cannot without its *Subject*; but we can clearly and distinctly apprehend *Cogitation*, at the same time secluding all *Corporeal Substance*, nay denying that there is any such thing in *Rerum Natura*. So that *Cogitation* cannot, as a *Mode*, be attributed to *Matter*, and consequently *Cogitation* is utterly a stranger to *Material Substance*.

XXXII. Regius *his Argument against the Premises.*

Some there be, who perhaps adhering to the Opinion of HENRICUS REGIUS will maintain that what we have said is only true, so long as no *Existence* yet appears; but nothing less if it be supposed to be *in Rerum Natura*; for then what should hinder but that it may be modified by *Cogitation*, and gain a new denomination by the presence thereof? For altho' perchance one should know for certain, that he carries about him in his Purse the *Effigies* of *Cæsar*, but knows not whether the *Graving* be in *Gold*, *Silver*, or other *Metal*, he may safely affirm that he hath *Cæsars Image*, tho' no representation of *Gold* or other *Metal* occur to him at the same time. Nay, tho' a doubt should come into his *Mind*, whether any such thing as *Metal* be to be found in the *World*, yet nevertheless it cannot be thence inferred, that the *Image* of *Cæsar*, and the *Gold* or *Silver* it is graven in, are two distinct things, tho' apart one may understand them to be so. In like manner, tho' one may possibly conceive *Cogitation* as a *thing* distinct from *Body*, yet we cannot rightly conclude that they are two *Substances* distinct from each other, induc'd only by this motive, that we can conceive them separately one from the other.

XXXIII. Regius *his Argument solved.*

But this or any such like example that may be brought by our *Adversaries*, is so far from favouring them, that it rather makes against them, and strengthens our Assertion; forasmuch as not *Gold*, or any other *Metal* is the Primary *Subject* of *Cæsars Effigies*, but Extension; that is to say, that the *Gold* in which *Cæsars Effigies* is *Graven*, is not therefore susceptive of that *Image*, because it is the Nature of that *Metal* to be so; for then *Images* could be made of *Gold* only, and no other *Metal*, but because *Gold* is a *Material Substance*, that is, a thing extended, and in which the *Images* of any *Men* may be impressed or drawn. On the contrary, this *Example* makes on our side: For if upon this account, namely, because some one carries the *Image* of *Cæsar* in his *Purse*, and considers the same in his *Mind*, he cannot therefore imagin that there is such a thing as *Body* in the *World*, and consequently that the said *Image* ought to be the *Mode* of the *Body*: I find not why by the same Reason we may not infer, that *Cogitation* belongs not to *Body*, or is not an *Attribute* thereof, since we can suppose, that there is no *Body* existing in *Rerum Natura*, at the same time that we perceive we think. It appears therefore manifest in the conception of *Cogitation*, that nothing of *Matter* is concerned therein; and that *Body* whatsoever *Figure* it may receive, and howsoever agile, pure or subtile it may be supposed, cannot conduce any thing to Perception; for if a *Corporeal Thing* be indowed with Perception, and apprehends *Objects* offered, what distinction will there be between *Soul* and *Body*? After what manner will *Animals* differ from *Men*? How will *Brutes* be *Brutes* if they enjoy the use of Reason, and have the same Sense as we; if in the same manner they *Perceive*, *Imagin*, *Judge* and *Discourse*? In vain doubtless *Men* challenge to themselves Rationality, and boast of a *Spiritual Soul*, so long as there is allowed a Matter capable of those Functions which belong to *Incorporeal Substances*, and distinguish them from other things.

XXXIV. Hobbes *his Reason to prove Cogitation to be a continual Motion.*

But methinks I hear Mr. HOBBES crying out, that there is no necessity I should have recourse to an *Immaterial Principle* for the producing of *Cogitation*, since *motion it self, or the reaction of one part of matter against the other, or at least a due continuation of the said reaction can as well effect the same.* For who finds not in himself that the *Head* is heated, and that all parts of the *Brain* are disturbed and out of order, when a Man is excessively taken up with serious *Contemplation*, or very eagerly confines himself to his Study for a long continuance of time? This certainly would not happen if *Sensation* or *Perception* were not the work of *Matter*, or proceeded not from the agitation and *motion* of its *parts*, which being granted, what should gainsay, but that the diversity of *Cogitations* may be allowed to arise from the diversity of the *Reactions* of *Parts* upon each other, namely, while they compress themselves divers ways, and react, and are as it were beaten back upon one another? Whereupon such will be the *Cogitation* of every *Particle*

as the *motion* produced therein, and as this or that pulsation or pressure shall happen among them.

XXXV. Hobbes *his Hypothesis examined and argued of Falsity.*

Mr. HOBBES would make out something by this Argument if he could, first so far bring us to his Opinion, as to believe that there is nothing substantial existing in the *World* but *Matter*, and that whatsoever is produc'd, is extensive and divisible. For when as it is certain that *Men* are indow'd with *Perception*, and receive impressions of *External Things*, from *Organs* destin'd by *Nature*; were this *Hypothesis* granted, there could not in my judgment, be assigned a more proper cause of Perception, than Reaction of one part of Matter upon another, and variety of Motion excited therein: But whereas this *Hypothesis* is altogether false, and it is certain that this *World* contains something thing else besides a meer heap of *Bodies*, and that what is in no wise *Corporeal* makes up a great part thereof; Mr. *Hobbes* must excuse me for being of a different Sentiment, and totally averse from his Opinion. For according to this *Doctrin*, what should hinder but that *Animals* not only laid asleep in their *Dormitories*, but even their very *Carcases* after the *Vital Flame* is extinct, may be said to be sensible, and to be indued with the power of Perceiving, when as they are then no less capable of Reactions and susceptible of *Corporeal Impressions*. What should hinder but that the *Eye* of a *dead Ox* may be affirmed to *see* and *perceive Objects*, being so let in at the Casement of a Window, that the *fore part* thereof may look towards the *Floor* and several *Objects* illuminated by the *Sun*; and the *hinder part* the innermost recess, which being all dark, must admit of no other *Light* but what enters by the *Eye*, all the *Tunicles* being taken away at the bottom, and to hinder the humour from falling, an *Egg-shell*, or some other *white Body* applied, by which at the same time one may behold the Image of *External Objects* no less distinctly formed therein, than they are form'd upon the *retin Tunicle* of a *living Animal*, especially if it be prest somewhat more or less, according to the distance. Well may the *Head* ake in serious *Meditations*, and some parts of the *Brain* be in an extraordinary manner disturbed, in regard such sort of *local motions* do only denote that the *Mind*, so long as it is tied to the *Body*, depends upon certain *motions* of the *Body*; and that the *action* of the *Body* intervenes our sensations. So that to make us sensible, it must be required that an *Organ* of some one of our *Senses* be disposed in some such certain way as cannot be done without *motion*: For there is a great difference between that which in our sensations hath reference to the *Body*, and that which belongs to the *Mind*. *Motion* indeed impresses an *External Object*, and the *mutation* of an *Organ* and of the *Brain* relate to *Body*, but that comprehends no Perception, because that Perception consists not in *motion*, nor in *reaction*, nor in *impression* of *Species*, but in the conscientiousness or internal *Cognition*, which of our selves we immediately perceive, when we are conscious of those things which we do, or which are performed in us: But since such a Conscientiousness is something altogether distinct from *local Motion*, the Essence of *Cogitation* cannot consist in *local motion*.

But let us examin a little more closely the Nature of *Matter*, and divide it into *Monades* or the most Minute *Physical Particles*. Next I inquire whether each of these *Monades*, separate from each other, can perceive, or are capable of *Sense*, or the whole Composition only resulting from them? I cannot suppose any one so much a friend to *Atoms*, as to attribute *intelligence* to any one single *Atom*; for who can be so stupid as to believe that the least *particle* of *Matter* imaginable, can be indued with *Sense*, and perceive, and think upon impressions of *Objects* coming from without; but if the whole, consisting only of these *Monades*, perceives, and is indued with *Intelligence*, by what means, or by what artifice can it be brought to pass, that of things insensible, a thing capable of *Sense* should arise? How from the various coition of *Atoms*, which are void of all quality, an *Animal Cogitant*, that is, *Seeing*, *Hearing*, *Perceiving*, &c. can result? It is most evident that if when the *Flesh* is prick'd with a *Needle*, one *Atom* feels it not, two, three, four or more will never feel, no more than if an incision were made into the sides of a mass of *Adamants*, or other invulnerable things. And as *Fingers* connext, are separated without pain, so it is most evident that *Atoms* only conjoined with one another, may be divided without any *sense* of *Pain*: And for the better confirmation of this matter, we have *Plotinus* concurring in a high degree: *If any one*, saith he, *shall affirm that the concurrent Atoms make a Soul, he is refuted by the consention of Passion, and the copulation of Nature; forasmuch as a thing cannot intirely be one and compatient of Bodies not patient, nor admitting any union, and yet the Soul may be altogether compatient to it self.*

XXXVI. *Not the parts of Matter, nor the whole, consisting of those, can be capable of Cognition.*

XXXVII. *How a thing sensible, according to* Gassendus, *may be made of insensible things.*

The most Famous GASSENDUS, following *Epicurus* in this matter, answers, that one *Atom* is indeed void of *Sense*, but that nothing hinders but that Nature commixt after a certain manner, of many *Atoms*, may be capable of Alteration and Sense, and consequently that it is no wonder if a heap of *Adamants*, and such like *Materials* is not sensible, in regard it is not so composed, nor consists of parts so affected as to obtain the power of being sensible; for he is of *opinion*, that sensible and insensible differ not much otherwise from one another, than a thing *kindled* and *unkindled*; and as we see, saith he, a stick of *Wood* lighted by a *Torch*, and a *Flame* created in a new *Subject*: So what hinders but that a sensible thing may be made of insensibles, and that from dead things, as I may say, living may arise?

For as *Lucretius* saith, as *Living Flesh* is formed of *Bread* or *Herbs*, which are insensible; and as from insensible *Wood*, certain particles may be produc'd, which so long as they are infixt into the *substance* of the *Wood*, remain unmoved, and as it were stupid and benum'd; but upon the approach of *Fire* to them, are streightway roused and put into *motion*; and being thus disposed into a new way of proceeding, they become invested with a power of *giving Light* and *Warmth*: So it is to be understood that the *Fiery Particles*, so long as they are divided, and lie skulking as it were in the *Bowels* of *Matter*, are quite destitute of *Sense*; but when once they expand themselves, and rally into a state of *motion*, they agitate, ve-

gitate and animate what ever *Body* falls to their Province, and impart Senſe and Perception to it.

XXXVIII. *It is repugnant to Reaſon, that Senſe ſhould ariſe out of Inſenſible things.*

Altho' we ſhould willingly yeild to GASSENDUS in what he aſſerts, and grant that the *Soul* is kindled in the *Body* like *Fire*; and that the *Senſe* is that part thereof by which it is diſtinguiſhed from other inſenſible things, yet ſtill there would be no leſs difficulty to apprehend how it ſhould come to paſs, that ſince the *Atoms* of *Fire* or *Flame*, being divided from each other, do not perceive, or are ſenſible they ſhould obtain the faculty of being ſenſible, or perceiving, when they come into conjunction, and are as it were aſſociated and link'd together. For the grand *Quære* will ſtill be, by what way, or after what manner, out of thoſe mixt *Monades*, Perception ſhould ariſe, and from their union ſo great a power ſhould accrew, that thoſe things which before were inſenſible, ſhould be rendred ſenſible. Here GASSENDUS is at a ſtand, and ingenuouſly confeſſeth that he cannot conceive, how a *thing wanting Senſe* ſhould, being mixt with others, procure *ſenſation*, and give that perception to others, of which it is deſtitute it ſelf. Indeed, ſaith he, we muſt confeſs there is little hope of appearance how this thing can be manifeſted, ſince either we are altogether deceived, or all human Wit is wholly at a loſs to comprehend what the Contexture or Contemperation ſhould be either of this *Flame* to entitle it to be thought the *Soul* or *Principle* of *Senſe*, or of that part or *Organ*, which being *animated* and *vegitated*, the *Soul* makes uſe of to perceive by. True it is, that a little after he brings certain *Examples* to make out the progreſs, by which ſenſible things may ariſe out of inſenſible; firſt by the *Fruits* of *Trees*, which of *ſour*, become *ſweet*; of *unſmelling*, *odoriferous*; of *green*, *yellow*; in a ſpace of time ſo imperceptible, that at the beginning nothing of that quality which ſucceeds can be diſcerned; and for the moſt part toward the end, nothing of that which was at the beginning; by which he labours to inſinuate, that in the like progreſs of time, that is imperceptible, a thing inſenſible becomes ſenſible and perceptive, which was at firſt void of *Cognition*.

XXXIX. Gaſſendus *his Examples prove not that a thing Senſible can be made of Inſenſible.*

But theſe *Examples* of GASSENDUS ſignifie little, for it is eaſie to be underſtood, that *Fruit* whilſt it is ripening *changes* its *Savour*, and that that which was *ſour* becomes *ſweet*, namely, becauſe the *Juice*, ſubdued by the adjutant *Heat* is refined, concocted, and ſtrained, by which *action* the rough *Particles* breaking forth, the digeſted humour remains, which gratifies the *taſte*, and produces a grateful *ſavour*; and for the *Colour* we may eaſily enough apprehend how the *Fruit* changes, and laying aſide its *Green Colour* puts on a *Yellow*, that is to ſay, while the *Fruits* are ripening, the percolation is perfected, the parts ſubdued, the juice purified, which ſwells, froths and ferments; all which things, ſince they cannot be without tranſpoſition of the *parts*, the *colour* alſo conſequently muſt needs be changed, and its aſpect affect the *Eyes* in another manner than formerly. But we can by no means conceive that many *Atoms* joined together can beget *Perception*, and that from their various Perception a Senſitive Faculty ſhould ariſe. For ſince *Conſciouſneſs*, as hath been before obſerved, is included in *Cognition* and *Senſation*, the *Atoms* or *Monades* of *Matter* cannot obtain ſuch a Diſpoſition, or ſo enter into an Aſſociation one with another, as to produce that affection in the *Body*, as being proper to *Immaterial Subſtance* alone, and inſeparable from it.

XL. *Cogitation can no way belong to a Corporeal Soul.*

Beſides, it is very difficult to be underſtood how *Cogitation* can be received into that *Corporeal Soul* which they call *Igneous*; for either *Cogitation* is received whole, in the whole Matter, or whole in ſeveral *Monades* or ſmall *Particles*: Or laſtly, The ſeveral *parts* of *Perceptions* are in the ſeveral parts of the *Matter*. If the whole *Matter*, that is, the *Soul* of the *Brute*, admits the *ſpecies* of an *Object*, it appears not how the *Senſes* can be diſtinguiſh'd in it, ſince each of the *Monades* muſt ſupply the place of a *Senſorium*, and the emitted *Species* be promiſcuouſly effuſed; for how ſhall the *Ear* be deputed for the receiving of *ſounds*, rather than the *Eye*, if in the whole *Soul* this ſenſation be received, and every *particle* thereof *hears*, and is ſmitten with the undulation of the *Air*? Why ſhould the *Eye* rather than the *Noſe* be aſſigned the *Organ* for the diſcovery of *Objects* without, if the whole *Soul* by a very ſwift perception apprehend things far diſtant, and in every point thereof the *ſpecies* of *things* be repreſented? And ſo in like manner of other *Senſes*. But if the ſeveral parts admit the whole *Image* of the *Object*, one point of the *percipient* muſt needs behold innumerable *Species* of one and the ſame *Object*, and equal that *Object* by which it is exceeded almoſt an infinite number of *Senſes*, which I think no *Man* in his right *Senſes* will allow. For how can it poſſibly be imagined, that one *Phyſical Monade*, which is taken for granted to be the leaſt *particle* of *Matter*, ſhould receive the whole *Image* of any expanded *Object*, or variouſly tinctured *Colour*? If laſtly each part, of *Matter* anſwer to each part of *Perception*, the whole *Object* can never be diſcerned, in regard when each of the parts of the *Percipient* only admits each of the parts of the objected *Image*, there will remain nothing which can perceive the whole *Object*, and make the judgment thereof, no more than if three *Muſicians*, *ſinging* a *Song* of three *parts* were intent each upon his own *part* only, any of them could hear the part of the other, or be able to judge of the whole *Symphony*.

XLI. *If Brutes perceive, how are Men diſtinguiſh'd from them?*

The *Idea's* therefore of *Perception* and *Extenſion* are wholly disjunct, ſo that neither *Perception* can be the attribute of a thing extended, nor on the contrary *Extenſion* of a thing perceiving; neither doth it any way make for thoſe who believe that our *Souls* die with our *Bodies*; foraſmuch as if we grant *Cogitation* to *Beaſts* in like manner as to *Men*, certainly we muſt needs determine that our *Souls* are different from the forms of *Animals*, not ſo much in *Species* and *Nature*, as in *Degree* and *Perfection*; for if they can remember things paſt, perceive things preſent, and provide againſt things to come, and propoſe an end to themſelves, I ſee not what is left for *Man*, whereby he can have any *præeminence* over *Beaſts*, except perhaps that he performs the Functions with greater eaſe, and in a far more excellent manner; ſo that it is to be feared, if we ſhould attribute to *Beaſts* an intellectual Memory, and a propoſal of an end to any thing they do, and a certain reflexion upon any of their own *actions*, it would arm the

the Impious againſt the immortality of a *Rational Soul.*

XLII. *God can create Machins which may imitate the actions of Brutes.*

Now therefore that it is apparent and confirmed by divers *Arguments*, that *Matter* cannot be a principle of *Motion*, and that it is of ſo obtuſe a Nature, that it cannot be conſcious of any thing it ſuffers, or be able any manner of way to perceive any thing; who can be ſo bold as to deny that the Great *Creator* of all *things*, upon whoſe beck all *Created Beings* do depend, could have framed ſuch ſort of *Machins* as might reſemble the ſame *motions*, and exert all manner of *actions* exactly like thoſe which we ſee performed in *Brute Animals?* That *GOD* is able to frame ſuch *Machins* is confeſſed by all *Men*, and paticularly is clearly maintained and proved by the wiſe and learned St. *Auſtin*, in his 102*d. Epiſtle* in theſe words, *I wonder you ſhould believe that the ſound of the Voice, which ſaid,* Thou art my Son, *could be ſo uttered by a Corporeal Nature only, without the mediation of Human Thought, and only by Divine Inſtinct; and not conclude at the ſame time, that the Corporeal Species of any Animal whatſoever might not be made in the ſame manner, as likewiſe a motion like to that of a Living Creature, by Divine Will, without the interpoſition of any Animal Spirit: For if every Corporeal Creature be at GOD's command without the Miniſtery of a Life-giving Soul, ſo far as that ſuch ſounds may be uttered as come from an Animate Body, and by which an articulate form of ſpeaking may be conveyed to the Ear; why may not the like obſequiouſneß be ſhewn in this, that without the Miniſtry of a Life-giving Soul, a Figure and ſwift Motion, may by the ſame power of the Creator, be conveyed to the ſight?* I will not here repeat what I quoted in the *Preface* concerning a *Machin* which carried *Letters* to the *King* of *Morocco.* Who can but admire that a portable *Dyal* or *Watch*, ſhould by a certain *figure* of *parts*, *diſpoſition* of *Wheels*, *Spring* or *elaſtick Force* of *Steel*, meaſure the *times*, and declare to the leaſt part of a *Minute* all the *Hours* of the *Day* and *Night?* Who without wonder and aſtoniſhment can think of that *Machin* which Sir *Kenelm Digby* affirms he ſaw in the *Mint* of *Segovia* in *Spain*, which was contrived with that Artifice, that every part thereof had its various Offices, and was aſſigned for its proper Action. One part extends into its due *latitude*, the Maſs of *Gold* or *Silver*, and gives it that thickneſs which the *Coin* requires; the next to this ſhapes the *Plate* ſo diſtended, and deſigns the *Stamp*; and having ſo done, tranſmits it thus *ſtampt* to another, from which it receives its *Weight* and due *Figure* according to the *Stamp* impreſt upon it. At length the *Coin* thus perfected, is conveyed into a receptacle built for that purpoſe, where he, whoſe Office it is to collect and keep the ſame, finds all the *Mony* ready prepared to his Hand. Who could be otherwiſe than highly aſtoniſhed that had ſeen *Dædalus* his *Wooden Venus*, which with *Rowling Eyes* ſeem'd to look upon, and take a perfect view of all *Spectators*, and likewiſe to move up and down with her *Feet*, and exactly to imitate all the *actions* of a *Woman*, ſo that ſhe might be judged by all to be a *Living Creature*, and to have a free faculty of moving from place to place?

XLIII. *Several Machins made by Man to imitate the motions and actions of Brutes.*

Who can but wonder that hears of the *Wooden Pigeon* of *Archytas* the *Tarentin*, which having *Wings* ſet on it, flew up and down like a *Living Bird?* No leſs an object of wonder was that *Statue* of a *Man*, framed by *Albertus Magnus*, which moved up and down with diſtinct *Steps* and *Paces*, and uttered *Words* as articulate as any *Human Voice* could utter. Moſt wonderful alſo is that which Hiſtorians report of the *Norimberg Eagle*, which was ſo framed by *Athanaſius Kircher*, that it flew to meet the Emperor *Maximilian*, and hovering with its *Wings* over his *Head*, accompanied him all the way in his return to the *City*. To conclude, the *Statue* muſt not be forgotten, which being made by an Ancient *Artiſt*, and ſet upon a high *Mountain*, ſaluted the *Sun* each *Morning* at his *Riſing* with a *Hymn*, compoſed in exact *muſical Harmony*. Yet no *Man* can be ſo fooliſh as to imagin, that in ſuch like *Machins*, there is any *Soul* or *Cognition* required for the performance of all theſe things; but on the contrary muſt of neceſſity acknowledge, that all operations of this *Nature* proceed from *Figure*, *Order*, and a certain *magnitude* of *Parts*. Why may we not therefore conclude the ſame thing of *Animals*, ſince all their *parts* may be ſo fitted and connected that the ſame circuit of *Blood*, the ſame vigour of *Spirits* may actuate them, as we find to be in a *Living Dog*, ſince thoſe various movements, fram'd by *Human Induſtry*, are effected by the help of little *Wheels* and other *Inſtruments*, which are but very few in compariſon of the almoſt infinite multitude of *Bones*, *Muſcles*, *Nerves*, *Arteries*, *Veins*, and other *Organick Parts* which are in the *Body* of every *Animal?* And therefore no wonder if this ſort of *Machin* have more admirable *motions* than any that can poſſibly be made by Human Art.

XLIV. *The compariſon of a Living Dog with the Automata made by Art.*

But to make out more clearly the ſimilitude between theſe *Automata* made by the *Hands* of an *Artiſt*, and real *Animals:* Let it be ſuppoſed that *GOD* ſhould compoſe a *Machin* exactly imitating the *Actions* and *Paſſions*, for Example, of a *Dog*, and place it among other *Dogs*, by what ways and evidences ſhould we be able to diſcover the true *Dog*, whoſe *movements* are thought to be effected by *Cognition* and *Deſign*, from the *Machin*, whoſe *motions* and *actions* are all produc'd by the diſpoſition only of its *Organs*, and the impulſation of *Objects?* Certainly I think no manner of ways, for that there might be juſtly aſſigned to both a like force, like Ingenuity, and an equal faculty of Acting, Moving and Thinking. Now to make the matter a little more manifeſt, let us take into examination what that *Mans judgment* would be, who ſhould live confined in a deſert *Iſland*, and being barred from the ſight of all *Animals* which we call *Brutes*, ſhould through the whole courſe of his *life*, ſee no other *Creature* but *Man*, and who at the ſame time ſhould be addicted to *Mechanick Arts*, and to imploy his time wholly in the making of theſe *Automata*, or at leaſt to be converſant with thoſe who made it their buſineſs to frame *Machinaments* of divers ſorts; as of *Man*, *Horſe*, *Bird*, &c. Let us alſo ſuppoſe that theſe *Automata* did not only *go* up and down, *eat*, *breath*, &c. but alſo ſo far imitate all the *motions* of *Animals* as to repreſent their perfect *Species*, in ſo much that upon a blow given,

given, they ſhould ſet up a *Cry*, and with great noiſe and tumult betake themſelves to their *Feet*; nay more, ſhould come when they were called; in a word, ſhould do all things which Men are wont to do when they are hurried with *paſſions*, and wreath themſelves into various *motions*: Undoubtedly this Man, ſetting aſide all ambiguity, and uncertainty of Mind, would judge ſuch ſort of *Machins* to be real *Animals*, and that they *live*, *move*, *act*, *deſire*, *think* and *know* as we do. As a certain *Prince* of the *Chineſes*, when he firſt ſaw a WATCH, judged it indued, not only with *Life*, but alſo with *Senſe* and *Reaſon*, in regard of the conſtancy of the *motions* which he obſerved in it, till upon the opening of the *Watch*, the ſight of the *Wheels* wound up into *motion*, diſcovered the *Artifice*, and awakened him out of the error he had entertain'd.

XLV. *Whether theſe Machins can be called Animals.*

It will be doubtleſs replied to all this, that ſhould *GOD* frame *Machins* to move thus by *Springs*, however they could not be called *Animals*, ſince an *Animal* is not a thing which meerly moves and makes a noiſe, for ſo a *Machin* may eaſily be made to do, but that it is in the nature of an *Animal* to be ſenſible, and to perform all its *motions* by a vital and internal *Principle*, which hath the faculty of perceiving and being ſenſible, which Properties can never be allowed to a *Machin*. But the grand matter in diſpute is, whether it be in the Nature of *Animals* which have not a *Spiritual Soul*, to *think* and *perceive*, and we ſay *no*: And that all we obſerve of *Beaſts* is, that they are but *Corporeal Movements*, and ſo a *Machin* may be; ſo that to ſay that theſe Movements proceed from a *principle* which *perceives* and is *ſenſible*, is to Divine. Moreover it is impoſſible they ſhould act in ſuch a manner, at leaſt ſo far as to be allowed *Souls* wholly *ſpiritual* as the *Soul* of Man is.

XLVI. *The Error of thoſe, who from the external form of the Members of Brutes, imagin they are indued with Cognition like us.*

Hence we may ſee how groſs their *Error* is, who obſerving that the Members of *Brutes* differ not from ours in the *external form*, and that their *motions* are like to our *motions*, preſently infer that the ſame *principle* is common to both, and conſequently that there is a *Soul* in us which produceth theſe *effects*, and which imparts *motion* to the *Body*, and is indowed with the faculty of *thinking*; ſo that there muſt needs be a *Soul* in *Animals* which executes the like offices, or which actuates their Members, and is a principle of *Cognition* in them: For ſay they, it is not to be doubted, but that there is great affinity between divers *actions* of *Animals*, which gives the youngeſt capacity occaſion to judge that they perform their *actions* in like manner as we do, and by the means of the *Soul*, have *paſſions* alike; that they have an Appetite to *things* agreeable to them, and an averſion to *things* diſagreeable; that they delight in ſome *Images* of *Objects*, and dread the ſight of others: But the truth is, if we come to a ſtrict examination of the matter, and inquire throughly what that is which we make the principle of *Animal Functions*, it will evidently appear, that we are led out of the way by a meer Childiſh prejudice, and that we are prepoſſeſt with this Opinion, only by a natural and unthinking apprehenſion of things; for if theſe ſorts of *Machinaments* were ſet before our *Eyes*, we ſhould find no footſteps of Reaſon in them, tho' never ſo much reſembling the *Species* of a *Dog* or a *Horſe*, or ſhould imitate all their *actions*; and hence it is to be concluded, that *Animals* are indeed nothing but meer *Machins*, deſtitute of all *Cognition* and *Senſe*.

XLVII. *What difference is between Men and Brutes.*

Why may not, you will ſay, the ſame judgment be given of *Machins*, repreſenting our *Bodies*, ſince thoſe alſo imitate *Human Actions*, and have *motions* as like as may be, to ours; and conſequently as we infer that *Machins* like to *Animals* are void of *Cognition*, ſince we ſee the ſame or the like Actions in the *Automata* which are framed after their *Species*: By the ſame *Argument* it might be inferred, that Men alſo are deſtitute of *Cognition*, becauſe their *motions* are altogether like to thoſe in the *Machinaments*, as to the external *Figure*, and it is apparent that *Apes* have all thoſe which appear in Men.

To this I anſwer, that tho' thoſe *Automata* repreſent the *Figure* of Men, and imitate as much as morally can be all our *Actions*, yet they are to be diſcerned from real Men two manner of ways; Firſt, becauſe they could never be indued with the faculty of ſpeaking, ſo as to expreſs their *thoughts* by *words* or *ſigns*, or to anſwer appoſitely to thoſe *things* of which they might be interrogated, as Men in *diſcourſe* uſe to; who by certain *ſigns* open their *Mind* to others, and diſcover the ſecrets of their *Hearts*: For tho' we may fancy a *Machin* made with that Artifice, as to utter, nay diſtinctly to pronounce certain *words* which may exactly anſwer the preſentment of *Objects*, moving its *external Organs*; as for example, if it ſhould chance to be ſmitten in ſome one part, it may act what we mean, and if it be toucht in another part with a lighter *Hand*, it may ſay we favour it, and ſuch like expreſſions; yet never ſo as to adapt its *words* appoſitely, and in a proper ſtile, ſo as to anſwer congruouſly to all things that may be propoſed to it; as we find daily Men of the meaneſt capacity, and ſometimes thoſe hardly in their *ſenſes* to do. The Second way is, that altho' the *motions* of ſuch *Machins* are orderly, and ſometimes alſo exceed the *motions* of the wiſeſt of Men, yet in many things they err, and deviate moſt from us in thoſe things wherein they ſhould chiefly imitate us. Whence it is manifeſt, that thoſe ſort of *Machins* are not conducted by *Reaſon*, nor indued with *Cognition*, but impelled to theſe performances by the diſpoſition of their *Organs* only. Whereas Men, tho' never ſo ſtupid, nay even ſenſleſs, are able to put divers *words* aptly together, and of them to compoſe an orderly *Speech*, whereby they can diſcover their *thoughts*, and declare what they *deſign* in their *Minds*. On the contrary no *Animal* is found ſo perfect, and born under ſo favourable a *Star*, that he can approach towards *intelligence*, or perform any thing that can come near it. All which happens to *Beaſts*, not through the imbecillity of their *Organs*, nor through the *defect*, nor impotence of forming *words*; foraſmuch as we find by experience, that *Magpies* and *Parrots* are *Loquacious*, and utter human expreſſion, yet cannot *ſpeak* as we, that is, in ſuch manner as that by uttering certain *words*, their *anſwers* can correſpond to our interrogations, and manifeſt to us that they underſtand what they utter; whereas daily experience informs, that Men *deaf* and *dumb* from their *Birth*, (and doubtleſs ſuch Men have a defect in the ſtructure of their *Organs* more than *Beaſts*) yet in the

the ſame manner as we make uſe of *ſigns*; nay, and by their own ingenuity find out ſome ways to make known their *Conceptions*, and diſcover what they have in their *Minds* to thoſe with whom they converſe; which ſince *Brute Animals* cannot do, it is apparent that they are not only indued with a leſſer power of *Cognition*, but are altogether void of *Reaſon*; and that they not only want *Human Cognition*, but are alſo deſtitute of whatever other way can be thought on to expreſs themſelves; in a *word*, that they are *Automata*, and act not by *Choice*, but by meer impulſe: And here we are given to underſtand, how vain the Opinion is of ſome certain *People* of the *East-Indies*, who think that *Apes* and *Baboons*, which are with them in great *numbers*, are indued with *underſtanding*, and that they can *ſpeak* but will not for fear they ſhould be imployed, and ſet to work.

XLVIII. *The Brutes cannot diſcover their thoughts by any ſigns.*

But that *Brute Animals* are indued with no *Cognition*, may eaſily be demonſtrated; for if they could diſcover to us their *Cognition* by any *ſigns*, they muſt of neceſſity do it by *Speech*, or by ſome other notes, accommodated to whatſoever obvious *Object*, as namely, variations of their *voice*, or ſome other *Actions* of their *Body*, which ſhould be concluded on as ſigns of their *Cogitations*, and ſuch *ſigns* as ſhould not only ſignifie naturally, but by *deſign*. But ſince we can apprehend no ſuch ſigns in *Brute Animals*, and obſerve in them only *natural ſigns* of their *Paſſions*, and no moral or *deſigned marks* can be diſcerned in them; we may boldly conclude that *Beaſts* are not indued with any faculty of *thinking*. Now the Reaſons which induce me to aſſert, that there are no deſigned hints in *Beaſts* to be diſcerned, are eſpecially two. The firſt is, becauſe intimations by deſign, when they depend only upon the will and pleaſure of the thing *thinking*, and borrow their efficacy from the *will* thereof; it ſeems morally impoſſible but that they muſt be various according to the diverſity of *Times*, *Places* and *Perſons* concern'd, in regard the *Cognitions* and *Aims* of the thing *thinking*, can have no neceſſary connexion with the *actions* with which they correſpond. The ſecond is, that if the *Clocking* of a *Hen*, upon *notice* of a *Kite's* lying in *watch* for her *Chickens*, or the *Outcry* of any other *Animal* were plainly by deſign; it would be impoſſible for the *Chickens* or Young ones, ever to underſtand ſuch ſort of *ſounds* which are uttered at pleaſure, and according to the humour of the *Animals* that uttered them: For tho' the Young Ones of the *Swallows* mentioned by *Gaſſendus* upon the hearing of I know not what noiſe of the Old Ones, preſently fled away, and leaving the *Tree*, where they neaſted, followed the *tract* of their *Parents*: For ſo this Eminent Perſon relates, *viz.* that walking alone in the High-way, and paſſing unde a *low Bough* of a *Holm Tree*, he ſpied three young *Swallows*, who ſitting upon the ſaid *Bough* as he paſſed by, could not chooſe but ſee him, yet never ſtirr'd or offer'd to flie away; whereupon paſſing by the third time, he reached out his *Hand*, as it were to take them, yet ſtill they remained immoveable, no ſign being given to prepare for *flight*; but when the two Old Ones came to the place, and uttered I know not what kind of murmuring tone, they fled in an inſtant, and with a ſwift *Wing* betook themſelves to the *Air*. If this chattring were deſign'd, how could the Young Ones, being not long *hatch'd*, know it? Nay, which is more, and which exceeds all belief, how comes it that *Chickens* newly broke out of their *Shells*, and other *Animals* newly yeaned from their *Dams*, ſend forth *ſounds* always alike, and imitate the *Speech*, as I may ſo ſay, of their *Parents*? Theſe things ſufficiently declare that theſe ſort of *voices* are inbred, and that they are taught by nature to ſignifie and diſcover their Affections by certain *ſigns*.

XLIX. *There are in Man two principles of motion, Mechanical and Spiritual.*

Hence, as I ſaid before, may be gathered how groſly thoſe Perſons are deceived, who, becauſe they obſerve in *Brutes*, *Motions* like to thoſe in Man, and *Organs* alſo alike, perſwade themſelves, that there is the ſame principle of *motion* in them as in us, and that they proceed alike in both from the *Soul*; ſo that there muſt be a like *Soul* aſſigned to *Brutes*, upon which their *motions* depend: Contrary to whom we plainly diſcern that there are in us two *Principles* of our *motions* viz. one *mechanical* and *Corporeal*, which depends only upon the diſpoſition of the *Organs*, and a continual afflux of *Animal Spirits*; foraſmuch as the *Eſſence* of the *ſenſitive Soul* conſiſts only in the *motive Power*. Another *ſpiritual* and *incorporeal*, namely the *Mind* or the *Soul*, which we have formerly defin'd to be a *thinking Subſtance*, by reaſon that all its Nature and Property is placed in *Cogitation*. We have concluded that all *motions* as well in us as in *Brute Animals*, may flow from a *mechanical* and *corporeal Principle*, and conſequently that there is no neceſſity to imagin any *Soul* in *Brutes*, beſides the force of *ſpirits* and conformity of *members*.

L. *All motions in all Animals are explicated by a Mechanick Principle.*

The thing will more evidently appear, if we briefly, and as it were *in tranſitu* make out that all *motions* in Man are *mechanically effected*, that is, without any impulſe of the *Soul*, but only by the help of *Organs* and *Inſtruments*, as may be performed in a *Machin*, which the more happily to go through with, it will not be amiſs to begin from the motion of the *Blood*, becauſe on the *circulation* thereof depends the *animal Life*, which upon the ceaſing of the ſaid *circulation* is extinguiſh'd.

LI. *The motion of the Heart is performed without the help of the Soul.*

Suppoſe therefore according to DESCARTES, that in the *Heart* of the *Soul* there is a *fire*, not lucid, but as it were occult, and not much unlike that which is kindled in *Aqua-fortis* by throwing a ſufficient quantity of *pulveriſed Steel*, or which is to be obſerved in *fermentations*, or as ſome of the Moderns will have it, that a certain *heat* is excited by the help of the *Blood* in the *Heart*, not much different from that which ariſeth from the mixture of *Oil* of *Tartar* and *Oil* of *Vitriol*. But from whatever cauſe this *heat* of the *Heart* proceeds, whether from ſome external calidity, or from ſome corroſive *Salts* or *ſulphureous mixtures* acting mutually upon each other; or laſtly from the *Blood*, continually *circulating* through it: Certain it is, that the *Blood* impregnated with heat, muſt needs be dilated, and affect a larger place. For the *nature* of *heat* conſiſts in *motion*; and its chief property is to expand thoſe *Bodies* in which it is predominant, and to augment their bulk by diviſion of parts: As appears in *Milk*, *Oil* and other *Liquors*, which being held to the *Fire* grow turgid by degrees, and are inlarged by the con-

ceived Fervour; So that when by this latent *Fire* the *Blood* wherewith the cavities of the *Heart* are filled, becomes extended, and is necessitated to possess a greater *space*, it must pass from the right Cavity into the *Vena Arteriosa*, and from the left into the Great *Artery*, because these two *Vessels* are alway filled with *Blood*; and their *Orifices* which are toward the *Heart* cannot be closed up. This evacuation being made, however the *motion* of the *Heart* never the more ceases, by reason that the *Blood*, which had been rarefied in both *Ventricles* of the *Heart* being broke out through the *Vena Arteriosa*, and the *Aorta*, that little *Blood* which still remains in those *Cavities*, and that which being new, slides into the said *Auricles* of the *Heart*, are like the foresaid *Liquors*, of which one supplies the place of a ferment to dilate and heat the other, and this is the only thing which gives *motion* to the *Heart*, and causeth it incessantly to flow, and with wonderful swiftness to be diffused through the whole *Body*.

LII. *By the same Mechanick Operation the Blood circulates through the whole Body.*

But that we may the more easily conceive after what manner this *Motion* perseveres, and how the *Blood*, during Life, is carried from the *Heart* into the *Arteries*, and from them into the *Veins*, we must imagin that as often as the *Vena Arteriosa* receives the *Blood* just dilated in the right *Ventricle*, that very *Blood* propels other *Blood* with which it had been repleted before, and causeth it to exonerate it self of a part great thereof, and transmits it into the *Arteria Venosa* into which it flows, not only through those *Anastomoses*, which are discerned by the *Eye*, but also through infinite other *Spiracles* which are in the extremeties of the Branches of the *Vena Arteriosa*, and which meet in the extremities of the Branches of the *Arteria Venosa*. It may at the same time be imagined, that as often as the *Aorta* draws the *Blood*, which a little before dilated it self in the left Cavity of the *Heart*, that *Blood* thrusts forward other *Blood* contained in that Cavity, and compels it to free it self from that burthen, by driving it into the Branches of the *Vena Cava* into which it penetrates, not only by sensible *Anastomoses*, but also by innumerable other passages, which are invisible to our *Eyes*. From such a disposition of the *Vessels* which contain the *Blood*, it necessarily follows, that the whole *mass* of *Blood* flows about the whole *Body*, and still returning to the *Heart*, from which, as from its original Fountain it first sprung, is agitated and forc'd to move in a perpetual Round. For the *Arteries* and *Veins* of the *Body* are like *Rivulets*, through which the *Blood* incessantly, and with wonderful speed flows, taking its course from the *Veins* into the *Arteries* through the *Ventricles* of the *Heart*, as in *Animals*, yet living, is manifestly seen; forasmuch as upon the cutting of a *Vein*, the *Blood* flows out in an *intire Body*, and the *Veins* by degrees become lank, that is to say, the Liquor being let out wherewith they before swell'd. The *Blood* therefore being impell'd from the extreme parts of the *Body* towards the *Heart*, flows through the *Vena Cava* into the right *Lobe* of the *Heart*, and then into the *Arteria Magna*, which drives it upwards, downwards and sideways into the Great *Veins*, thence into the lesser, and oftentimes into the very substance of the *Flesh*, in regard the Branches of the *Arteria Magna*, being dispersed through the whole *Body*, are knit to the Branches of the *Vena Cava*; which at length carry the same *Blood* into the right *Ventricle* of the *Heart*, in order to begin a new Circuit.

LIII. *Whence ariseth the Pulse of the Heart and Arteries.*

Upon this continual *Circuit* of the *Blood* depends the *Pulse* of the *Heart* and *Arteries*; for since these two are no other than a *Species* of alteration which is perform'd by turns, and in such a measure that the *Pulses* of the *Arteries* answer to the *Pulses* of the *Heart*; it may be easily concluded, that those *motions* proceed both from the same *principle*, and consequently that that *principle* is no other than the very Alteration which the *Blood* undergoes in the *Heart*. Wherefore it is most rational to believe, that as often as any portion of the *Blood* falls into the two *Cavities* of the *Heart*, it mingles it self with another portion, which was there remaining before; which filling the inmost recesses of the *Ventricles* of the *Heart*, gains there a new degree of *heat*, and as hath been already hinted, gains a certain nature, as it were, of a Ferment; whence it comes to pass, that the substance of the *Heart* is forced to dilate and extend it self. Afterwards a greater portion, which was included in those Cavities, breaking forth through the *Aorta* and *Vena Arteriosa*, the *Heart* falls in and stretches its Longitude. And in this perpetual mutation of the Figure of the *Heart* its motion consists. The *Diastole* or Dilatation of it is when the *Blood* being rarefied within its *Ventricles*, the *Mucro* or point is drawn in towards the *Base*; the *Systole* or Contraction is, when the *Blood* being expelled, the *Heart* falls in, and comes to its proper shape; for the *Diastole* and *Systole* of the *Heart* are no other than its *Intumescence* and *Subsidence*, that is to say, as the *Blood* by turns *thrusts* forward and retires, the *Heart* alternately swells, and is depress't.

LIV. *Upon the motion of the Heart depends the Pulse of the Arteries.*

The *Pulse* of the *Arteries* follows the motion of the *Heart*, and consists chiefly in this, that by the *Blood* dilated in the *Heart*, and insinuating by a *motion* of *Vibration* through their *Tunicles*, they become *inflate*, as may be experimented in opening the *Breast* of an *Animal*, yet respiring and labouring for *Life*; for at the same instant wherein the *Finger* put to the *Artery* is impell'd, the *Mucro* or Point of the *Heart* is withdrawn to the *Basis*, and its Flaccid sides which are toward the right and left *Ribs*, are lifted up towards the *Midiastin-wall* of the *Heart*; and the side of the *Heart* which is directed towards the *Stern*, is totally, but especially at the *Basis* erected, and so the *Heart* is sensibly *inflate* and extended, beats the *Breast*, and begets a sensible *Pulse*; but the *Arteries* abate of their swelling whilest the force of the *Blood* is remitted, that is, some part of its *agitation* being lost, because then the *Arteries* sink and return to their pristin state, which may be discerned in the *Breast* of an *Animal* yet breathing, and especially being near the last gasp; for at the same moment in which the *Artery* ceaseth from its impulse, the side of the *Heart* which is towards the *Stern* appears to sink, and all its substance to become soft and *flaccid*, from whence it is apparent, that the *circulation* of the *Blood* is attendant upon the motions of the *Arteries*, and that this motion is reiterated as often as new *Blood* makes its *ingress* into the *Heart*, and is varied according to the diversity of qualities found in the *Blood*, which render

der it ſuſceptive of a quicker or ſlower *motion*.

LV. *That the Animal Life, as alſo the concoction of Meats depends upon a Principle only Corporeal.*

If the *Animal Life* depend upon a *Mechanick Principle*, if the *motion* of the *Heart*, the *pulſation* of the *Arteries*, the *flux* of the *Blood*, and its *circuit* through the whole *Body* proceed from a *corporal* and *mechanick Cauſe* only, what hinders but all other *motions*, for example, the *Concoction* of *Meats*, *Nutrition*, *Reſpiration*, and the like, may be attributed to the ſame *Principle*; when as we ſee that all theſe things, without any of our Labour, and even Sleep, are performed by the Functions of the *Soul*, and require no immaterial *Cauſe* to their aſſiſtance? For what is there of the *Mind* or of *Spiritual Subſtance* that intervenes in the buſineſs of *Chylification*, whether in the firſt or ſecond Concoction of the *Aliment*? What happens in *Meat* converted into *Chyle*, which may not be performed by *conformation* of the *Members*? The *Meat* well chewed and macerated by the *Spittle*, is conveyed into the *Stomach*; by whoſe *means*? Certainly by no other means but of the *Tongue*, and the *Oeſophagus* or Wind-pipe; the firſt of which having turned the *Meat* up and down ſome time in the *Mouth*, and being as it were the Hand of the *Ventricle*, commits it to the Mouth of the *Oeſophagus*, and by a certain force caſts it in; the latter by the help of its *Fibres*, contracting it ſelf after the manner of an *Earthworm*, ſwallows the ingeſted matter, and conveys it farther in; but in regard the *Meat* is but lightly ſhred by the Teeth, and there ought to be a further diſſolution of it in the *Stomach*, ſo as to reduce it into *Chyle*, there is an acid and piquant humour, which iſſuing out of the *Arteries*, ſlips into the *Stomach*, and finiſhes the work begun in the Mouth. For ſince there are many Branches of the *Arteries*, which terminate in the interiour *ſuperficies* of the *Ventricle*, a great quantity of the foreſaid humour diſtills through them, which being mingled with the *Spittle* wherewith the *Meats* are macerated, helps their *digeſtion*, and alſo brings it to perfection, the ſaid *Liquor* being as it were a certain *Species* of *Aqua-fortis*, which getting in among the *particles* of the *Meats*, ſwallowed and eaten, help their diſſolution, and makes a *Chyle* out of them. The *Meats* thus digeſted, ſlip towards the *Inteſtines*, where the *Chymoſis* and *Hæmatoſis*, or ſecond and third *Concoction* may be ſaid to be performed, becauſe the *Gall* which flows into them, and which imparts a colour to the *Meats* as ſoon as ever they paſs out of the *Ventricle*, puts the laſt hand, as we ſay, and brings to perfection that which only was begun by the foregoing Liquors.

LVI. *How Sanguification is made in the Body of any Animal.*

The *Meat* thus diſſolved into *Chyle*, as ſoon as it hath gently and gradually flow'd through the *Inteſtins*, is preſſed forth, and is conducted through the *Lacteal Veins*, which running out in ſmall but almoſt innumerable *Pipes*, receive the Liquor as it grows white, and convey it into that which is called the *Pecquetian Receptacle*, ſo called, becauſe Dr. *John Pecquet* in his Book which he wrote concerning this matter, challenges to himſelf the firſt invention of it; from which Receptacle other *Chyliferous Pipes* ariſe, which proceeding directly upward through the Breaſt it ſelf, conduct it onward to the *Subclavian Branches* of the *Vena Cava*: From whence the *Chyle* running at that very place into the *decurrent Blood*; and being well mixt therewith, and paſſing through the *Vena Cava*, as well above as below, enters the *Heart*; where by a *fermentaceous effervеſcence* there excited by the heat of the *Heart*, it changes its *colour*, namely, from *White* to *Red*, whence appears the falſity of that opinion received by the *Antients*, namely, that the *Blood* is wrought in the *Liver*, and that the *Chyle* is carried through the *meſaraic Veins* in the *Meſenterium*, ſo into the *Vena Portæ*, and from thence into the concavity of the *Liver*, where it is peculiarly fermented, and as the *Chymiſts* call it, digeſted and ſeparated from the admixed *Choler*, and turns into a *Red Juice*; when as indeed no part of the *Chyle* at all arrives ſo near the *Liver*, as that it can thereby be changed into *Blood*: For how can it be, that the *Liver* ſhould create *Blood*, and bring a redneſs upon the *Chyle*, when not the leaſt part of the *Chyle* is ever conveyed thither, and it hath been ſufficiently made out by innumerable diſſections of *Animals*, that it paſſeth through the *Subclavian Branches*, and is by them infuſed through the ſhorteſt Trunk of the *Vena Cava* into the *Heart*.

LVII. *The Nutrition of Animals is made by the Circulating of the Blood through the whole Body.*

Theſe things have undeſignedly ſlipt my *Pen*, my intent being only in this Diſcourſe to deſcribe in a few words the *Oeconomy* of *Animals*, and to evince, that all the functions of the *Body* may be *mechanically* explained. Let us therefore follow the tract of the *Blood*, and go on according as we are led by the courſe thereof. The *Blood* being rarified in the *Body*, and going out with a force into the *Arieries*, it cannot be otherwiſe but that many *particles* thereof muſt make a ſtop in thoſe *members* which they are neareſt to, and there poſſeſs the place of ſome parts which they thence expel, and according to the *figure*, *ſituation* or exility of the *Pores* which they find, cauſe ſome parts rather than others to flow into certain places, in a manner not much unlike what we ſee done by ſome ſort of *Sieves*, which in regard they are contrived with holes of a different kind of bore, ſerve to ſeparate from each other *Grains* of *Corn* that are of various *Species*: or as the ſame *Rain* adapts it ſelf to *Plants* of a different kind, and in *Muſtard*, grows ſour; in *Rue*, bitter; and in *Liquorice*, ſweet; ſo the *Blood* being diffuſed through the whole *Body*, tranſmutes it ſelf into the ſubſtance of every part, and is diſpens'd according to the diverſity of their *Pores*, and *agglutinated* by a certain ſtreight Union. I have ſaid that the *particles* of the *Blood* ſtop in the *members* to which they are neareſt, and poſſeſs the place of others which they thence expel, becauſe it cannot be doubted, as experience teacheth us, but that there is a continual tranſpiration of ſenſible *parts* through the *pores* of the *Body*, and that ſome *particles* are ejected. For, *if we conſider the thing well*, ſaith the Famous *Gliſſon*, in his *Anatomy* of the *Liver*, *we breathe out almoſt as much again as we take in*; and when any one *breathes* upon a *Looking-glaſs*, a little *Cloud* is left upon it in the nature of a *balmy dew*: And as to what concerns the other parts, if by the inner part of the *Thumb* a little warm, a Plate of *Poliſh'd Silver* or *Pewter* be touch'd, the *Vapour* thence breathing out, will preſently leave a ſpot upon the *Metal*: And to him that conſiders well, that the ſame *expiration* is made from all parts of the *Body*, *Sanctorius* his *Calculation* will not ſeem much from the purpoſe,

who

who upon trial made of his *Obſervations* in this matter, affirms, *that of all we eat and take in, more than a half part is conſumed by inſenſible Evaporations*; nay, and that as much of *Aliment* is voided in a *day* through the *latent pores* of the *Skin*, as by *Stool* in fifteen.

LVIII. *Reſpiration is alſo Mechanically performed.*

With the ſame facility *Reſpiration* may be explicated, by the ſame *principle*; foraſmuch as the *Cheſt* being dilated by the help of the *Muſcles*, and eſpecially of the *Diaphragma*, the *Lungs* are inlarged or contracted, and by the means hereof we draw the *Air*, and immediately expel it again with the admixture of *Vapours*: For the *Diaphragma* is a certain *Muſcle* dividing the *Breaſt* from the interiour *Ventricle*, of a ſingular *Nature* and *Fabrick*, and aptly framed both for ſelf-motion, and for impelling the griſtles of the *Ribs* to which it adheres; whence upon its tending downward, the *Air* muſt of neceſſity enter the *Lungs* through the *Trachea*, or *Aſpera Arteria* for the effecting of *reſpiration*; but when the *Diaphragma* aſcends upwards to recover its former ſituation, the *Thorax* or *Cheſt* is contracted, by which means the *Lungs* are preſt, and expel through the *Aſpera Arteria*, the *Air* contain'd and kept in; and this is that which is called *Expiration*. Nor is it to be thought, as ſome will have it, that in *Inſpiration* the *Air* enters into the *Breaſt* for fear of a *Vacuum*; or that it penetrates into it ſpontaneouſly, and without any compulſion; for this ſort of attraction or ſpontaneous *Ingreſs* is a meer *figment*; when as the *motion* of *Bodies* cannot be performed but by *Pulſation*; for the external *Air* is brought into the *Lungs* for no other cauſe, but for that the Cavity of the *Thorax* is inlarged, and forcibly driven into the *Breaſt*, becauſe when the neareſt *Air*, the *Breaſt* being unfolded, is expell'd; and becauſe of its thickneſs, cannot plentifully and ſpeedily enough enter it; Nor, becauſe of the ſubtile *Matter* intervening and dilating it, be condens'd, it follows that it muſt needs be driven through the *Aſpera Arteria* into the *Thorax*, as we ſee daily in the blowing of a pair of *Bellows*, where the *Air* is propell'd into its cavity, while the ſides are expanded, ſo that the *Diaphragma* is of all parts ſerving to reſpiration, the firſt mover; and from whence, as from the *Fountain*, the *motion* of all thoſe *parts* ariſeth and depends: To believe which I am chiefly induc'd by this Reaſon, (tho' I could produce many others of no leſs moment) namely, that upon the opening of the *Thorax*, preſently the *Lobes* of the *Lung* fall in, and for a little ſpace are deprived of all *motion*, while at the ſame time the *Diaphragma* nevertheleſs intermits not its *motion*, but contracts and extends up and down, and attracts, as *Gaſſendus* calls it, and moves at once the *Griſtles*, and the extreme part of the *Spurious Ribs*, to which it adheres: Whence it comes to paſs, that the *Air* is attracted by a wound into the cavity of the *Breaſt*; ſo that no wonder if, as the ſame Author relates, the Wound hath ſometimes ſuck'd in a piece of *Candle* into it, as appears by the relation of *Bonanus* the Surgeon, who in curing an *Empyema*, near to the *Diaphragma*, when the better to make his inſpection for the extracting of the *putrid matter*, he drew aſunder the *Orifices* of the *wound* entring into the *Breaſt*, and bid the Servant hold a piece of a *lighted Wax Candle*; the ſaid *Candle* being not held very faſt, was ſnatch'd away, and attracted into the Wound, and not till after eight days ſpace, and the indurance of may grievous *ſymptoms* drawn out of the mouth of the *wound* with much ado; ſo that by this we may plainly ſee that it is the *Diaphragma*, which alone contributes to our *Natural Reſpiration*, when *aſleep*, or ceaſing from *pains* and *labour*; and that all the *Muſcles*, whether of the *Abdomen* or others, do nothing but obey its *motion*; whereas to a violent *Reſpiration*, and not Natural, and which at pleaſure we haſten, retard, reſtrain, intend or remit, ſomewhat more than the *Diaphragma* muſt contribute; ſince the *Organs* of voluntary motion are the *Muſcles*, and conſequently both the *Diaphragma* it ſelf is concerned, as it is a kind of *Muſcle*, and alſo other *Muſcles* as they attract, lay open, preſs and urge divers parts to which the *Diaphragma* is tied, or is contiguous.

LIX. *That there are Animal Spirits, and of what parts a Muſcle conſiſts.*

Beſides, the foreſaid *motions* of *Animals*, whoſe *Original* and *Cauſes* have been already treated of, there is another called *Muſcular*, to be made out; namely, that which is performed by the influx of the *Animal Spirits*, and depends altogether upon their *action*: Which the more clearly and eaſily to do, we muſt ſuppoſe in the firſt place, that by the name of *Animal Spirits*, there is nothing elſe to be underſtood, but the more vivacious and refined parts of the *Blood*, which being ſtrained as it were through a *Sieve*, through the Branches of the *Arteries* called *Carotides*, are ſeparated from the groſſer parts, and are thence conveyed through the *Veſſels* of the *Brain*; from which they are diffuſed through the *Nerves* into all the *Muſcles*: But why the parts of the *Blood* which *heat* hath rarified in the *Heart*, ſhould tend to the *Brain*, rather than elſewhere, there is no other reaſon to be given, than becauſe the *Arteries* which convey them thither, proceed from the *Heart*, by the moſt ſtreight Line, and are driven directly without any declination into the *Brain*; but according to *Mechanick Rules*, which are the ſame as the *Rules* of *Nature*, when divers things tend to one and the ſame place, where there is not ſpace enough, they muſt betake themſelves to any other where they can, becauſe the ways are very narrow, as happens in the *pores* of the *Brain*, the more ſubtile and more quick *particles* alone enter the *Brain*, the reſt diffuſing themſelves through all *parts* of the *Body*; ſo that thoſe which do enter, are to be look'd upon as moſt ſubtile *winds*, and pureſt *Flames*: In the ſecond place we muſt ſuppoſe that a *Muſcle* is not only *fleſhy*, that is, of a thin, and as it were *Spongy Subſtance*, the more eaſily to receive the *Animal Spirits*, but alſo many times contain *Nerve*, *Ligament*, *Tendon*, *Membrane*, *Artery* and *Vein*. It conſiſts of *Nerve*, as of a certain *Canal*, through which the *Animal Spirits* are deduc'd into it from the *Brain*, and the *Medulla Spinalis*: Of *Ligament* to render it the ſtronger, and be able to reſiſt the incumbent *Members*, and to exerciſe its *motions* the freer: Of a *Tendon*, that it may perform its motion the more promptly, and regulate its *actions* the more ſtrongly: Of a *Membran*, leſt the foreſaid parts of the *Organ* of *Motion* being deprived of a Covering, ſhould be expoſed to the injuries of *External Bodies*, and leſt the *Animal Spirits*, being entred into its ſubſtance, ſhould be diſſipated, and evaporate by *Tranſpiration*: Of

Veins

Veins and *Arteries*, thereby to ſupply it with *Aliment* and *Vital Heat*, by the influx whereof all the *Members* of the *Body* are enlivened and corroborated.

LX. *What a Muſcle is, and why the Ancients diſtinguiſh it into Head, Tail and Belly.*

Ancient *Anatomiſts* deſcribed the *Fabrick* of a *Muſcle* by a diſtinction of *Head*, *Tail* and *Belly*, taking for the *Head* of the *Muſcle* the Extremity joined to that part, at which the contraction is made; for the *Tail* of the *Muſcle*, they took the end or portion inſerted into that part which cauſeth *motion*; and laſtly, they called the *Belly*, that intermediate part of the *Muſcle*, which appears more tumid than the *maſs* of *Fleſh*. But we may further obſerve that a *Muſcle* is, as the Famous *Willis* hints from the moſt *Learned Steno*, either *ſimple*, which conſiſts of one only *Ventricle*, and two *Tendons*, of which ſort there are ſeveral in the *Arm* and *Leg*, which are the Movers of the *Fingers* and *Toes*; but they are alſo frequent up and down in other parts of the *Body*; or *Compoſite*, which hath ſeveral *Ventricles*, upon each whereof there hangs two oppoſite *Tendons*, yet ſo, that where-ever the *Tendons* are Compoſite, that is to ſay, two joined together, *one Compoſite Tendon may enter the middle fleſhy parts, and the other ſurround the middle fleſhy part on each ſide*; as moſt apparently is ſeen in the *Muſcle* called the *Maſſeter*, the *Deltoides*, and ſome others; in all which in like manner, as in the *ſimple Muſcle*, two *Fleſhy Fibres* (to which alone the Motive Power belongs) are contracted, and the oppoſite *Angles*, according to the inſertion of the *Tendons* are inlarged, and thereupon the *Ventricles* becoming ſhorter, and at the ſame time groſſer, riſe into a *Tumour*.

LXI. *The Motion of the Muſcles is made by the help of the Animal Spirits.*

Theſe things thus briefly, and by the by explained, we infer that the *motion* of the *Muſcles* is made in general, while the *Animal Spirits*, being ſwiftly moved, and like the parts of *Flame* ſhooting out from a Brand, being conveyed into the *Muſcle* by the conduct of the *Nerves*, and there copiouſly laid up, as in their proper *Promptuaries*, and dilating themſelves by their agility, enter into the *Carneous Fibres*, and become inflate, becauſe then the *Muſcle* contracted and expanded in Latitude, draws that part into which it is inſerted, towards the *Head* of the ſaid *Muſcle*; but when the *Spirits* retire into another place, the contraction is at an end; and the *Muſcle*, formerly more contract, becomes longer, and is reſtored to its priſtin poſition: So that the only cauſe of all the motions of the *Members* which are performed in an *Animal* is, becauſe certain *Muſcles* upon the *Spirits* emanation, are contracted, and thoſe which anſwer them on the adverſe part, by the departure of the ſaid *Spirits*, are dilated and extended.

LXII. *How it comes to paſs, that when one Muſcle is contracted another is dilated, and ſo contrarywiſe.*

But if it be ask'd why this *Muſcle* ſhould be rather contracted, than thoſe which are oppoſite to it, and all the *Fleſhy Fibres* of one *Muſcle* ſhould be drawn into wrinkles, and be more tumid and rough than thoſe of another? I anſwer, that it ſo falls out, becauſe more *Spirits* flow to this than to the other, ſo that they render it ſhorter, groſſer and broader. Not that the *Spirits* which immediately proceed from the *Brain*, are ſufficient to move theſe *Muſcles*, but becauſe they diſpoſe other *Spirits* which are already in theſe two *Muſcles*, to paſs out of one of them into the other; by which means that from which they paſs becomes longer and more remiſs; and that which they enter into becoming ſoon inflate by them, is contracted, and draws along with it the *Member* to which it is knit, which may eaſily be conceived, as *Carteſius* obſerves, if it be but ſeriouſly conſidered, that there are but very few *Animal Spirits* which proceed from the *Brain* towards any one of the *Muſcles*, but that there are always many others incloſed in that very *Muſcle*, which *Spirits* are moved therein with a very ſwift motion. Sometimes by moving only circularly in the place wherein they are, that is, when they find no open ways to get out at, and ſometimes by flowing into the oppoſite *Muſcle*, becauſe the Apertures are ſmall in every one of theſe *Muſcles*, by which the ſaid *Spirits* may flow from one to the other, and are ſo diſpoſed, that when as the *Spirits* which paſs from the *Brain* towards one of them, have a little more force than thoſe which paſs towards the other, they open all thoſe *Orifices* by which the *Spirits* of this may have a paſſage into the other, by which means all thoſe *Spirits* formerly contained in theſe two *Muſcles*, gain a very ſpeedy Conflux into one of them, and ſo puff up and contract that, while the other is extended and remitted.

LXIII. *The Force and Efficacy of the Animal Spirits in moving the Muſcles.*

And that *Animal Spirits* have this efficacy, is moſt evidently evinc'd from their agility and mobility; foraſmuch as in the twinkling of an Eye they paſs through the whole *Body*; and having in ſome ſort obtained the Nature as it were of an *immaterial Soul*, are carried with a moſt wonderful ſwift force into the *Muſcles*, and in a moment induce a change of *Figure* into the *Members*. Hence *Galen* in the 13*th Chapter* of his *Firſt Book De Motu Muſculorum*, *There is*, ſaith he, *in the Ventricle of the Brain, a Spirit, the firſt Inſtrument of the Soul, by which the Soul tranſmits both ſenſe and motion through all parts of the Body.* In the ſecond place we ſee in our ſelves, that no action of *Life* is performed, but by the help of the *Animal Spirits*; and hence it is that a Man having his *Spirits* exhauſted, faints and languiſhes: Likewiſe hence it is that the paſſage of the *Spirits* being obſtructed, the *Apoplexy* and *Palſie*, nay, the *Epilepſie* and *Vertigo* alſo ariſe: Alſo hence it is, that by a too intenſe ſtudy, the *Head* is debilitated, and a great diſſipation of the *Spirits* follows. In like manner as in a vehement *motion* of *Paſſion*, there is a perturbation of the ſame. Thirdly, The influx of *Animal Spirits* is plainly repreſented to the *Senſe*, by a *Snail* incloſed in a *Glaſs Phial*, as *Henricus Regius* obſerves; for as ſoon as ſhe begins to make her progreſs, firſt ſome, and then other *Spirits* with conſpicuous *Bubbles*, are continually driven on from the *Tail* to the *Mid Body*, and thence to the *Head*; but as ſoon as the ſaid *Snail* ſtops her progreſs, and lies ſtill, immediately the *motion* of the *Bubbles* from the *Tail* to the *Head* is alſo ſtop'd. Moreover, in the *motion* of the *Snail* there ſeems to be a certain circulation of *Spirits*, paſſing from the *Tail* by the *Belly* to the *Head*, and returning from the *Head* by the *Back* to the *Tail*, being thence again to take their progreſs as before.

LXIV. *How there ſhould be ſo great a force in the Spirits, as to move the whole Body.*

Now if any one ſhould object, that there ſeems not to be ſo great a force in the *Animal Spirits* as to be able to move the whole *Body*, ſince in regard they are the moſt ſubtile parts of the *Blood*, how ſhould ſo great a force come to be in ſo very thin

thin a matter as to ſtir up and down, not only the *Leg* or *Arm* of an *Animal*, but alſo to Move, Govern, Heave and Carry from one Place to another the whole *Machin* of the *Body*? Who can be made to believe, that ſo great a *Body* as that of a *Bull* or *Elephant* can be impell'd by ſo thin a ſubſtance, and be diſpoſed and excited to ſo ſwift a pace; nay and ſometimes to a kind of *Dance*? I anſwer that this needs not ſeem ſtrange at all, if we do but remember that the *Animal Spirits* have been already proved to be in the Nature of a moſt pure and ſubtile *Flame*, whoſe force appears no leſs in the *Body* of an *Animal*, than in *Fire* ſtirr'd up by *Gunpowder*, which being incloſ'd in a *Great Gun*, or *Piece* of *Ordnance*, cauſes it, tho' a thing of that maſſy bulk and weight, to recoil a great way backward, and ſometimes to burſt; and with that force to ſhoot out and drive into ſo ſwift a *motion* a weighty *Bullet*. Since therefore an *Animal* is a ſort of *Machin*, and all its *motions* are *Mechanically* performed, it muſt act according to the manner of other *Machins*; for example, *Bars*, *Wedges*, *Scales*, *Pullies*, *Cranes*, and the like, by which a ſmall help or ſtreſs being added, things of great bulk and weight are lifted and remov'd.

LXV. *Two ſorts of Bars which have an Analogy to the Organs of Motion in Animals.*

There are two ſorts of that *Engin* they call *Vectis*, ſaith the moſt learned *Gaſſendus*, which becauſe they draw up Burthens by *Cords* and *Ropes*, they have the more peculiar Analogy to the *Organs* of *Motion* in *Animals*, foraſmuch as one of the principal Motions is attraction, which is made by *Tendons*, as it were by *Cords*: Of theſe two ſorts of *Vectis*, the *Trochlea* or *Pully*, than which there is nothing more known, and *Tympanum* or *Peritrochium* which is alſo very much in uſe, that is to ſay, when the *Axis* or *Cylinder* being fixt to it at one end, and in another part ſuſtained by two Props upon which it may be turned, it winds about it ſelf the *Cord* faſtned to it at one end, and drawing up the Burthen by the other, is turned round by *Pegs* fixt into it all about this *Machin*. The *Latins* call a *Sucula*, a *Crane*; the *Vulgar Tornus*, a *Torn*. In the *Trochlea*, the Diameter of a ſmall *Orb* ſupplies the place of the *Vectis*, which bearing upon a little immovable *Axis* as its *Hypomoclion* or Underpropper, obtains a power of preſſion in that end where the *Cord* preſt by the Attractor, urges moſt; and becauſe the Burthen makes its ſtreſs upon no other extreme, but is tied to the uttermoſt *Cord*, it thence comes to paſs that while that extreme gives way to the preſſing power, or is lifted up; that part alſo of the *Cord* to which the Burthen is tied, is at the ſame time lifted up, and another Diameter, that is, another *Vectis* or Bar, and after that another immediately ſucceeds, and thus the attraction or lifting up of the Burthen is brought about; whereas in the *Tympanum* or *Sucula*, every *Scutula* or *Peg* is apparently a *Vectis*, in the extreme whereof the force is incumbent from the *Hand*, deducing or drawing down; and whereas the *Fulciment* or *Prop* is allowed to be in the *Cylinder* it ſelf, another extreme *Fulciment* muſt be allowed to be at the adverſe part of the *Cylinder*, upon which in regard the Burthen makes no ſtreſs, but hangs upon the main Rope, it thence comes to paſs, that while that gives way, the Rope, is wound about the *Cylinder*, and being ſtill ſhortn'd as it *winds*, lifts up the *weight*, and this is continued by *Pegs* or *Bars*, continually ſucceeding one after another: Now in an *Animal* there are not indeed ſuch things as *Trochleæ* to be ſeen, but to ſupply their place, there are ſo many as it were *Corrugations*, by which the *Tendons* are contracted, and the *Muſcles*, themſelves abbreviated as to *Longitude*. So that from them proceeds as it were a certain Series of *Trochleæ*, in imitation of the *Polyſpaſtic*, whoſe force is wonderfully vaſt; nor doth there appear any *Circumduction* or Winding about, in regard the revolved *Tendon* is ſhortned, neverthelſs there is that which ſupplies the place thereof; namely, the Contraction, and as it were Complication of the *Tendon* upon it ſelf, by the help of the *Animal Spirits*; whence it follows, that the part contracted comes nearer and nearer to the Head of the *Muſcle*.

LXVI. *It is concluded that Animals are meer Automata.*

From this ſimilitude of the *Vectis* with the *Machin* of an *Animal*, and from the manner by which we have above made out, that the functions of the *Body* are performed; it is clear enough evinc'd, that there is no neceſſity of a *Soul* in *Beaſts*, for the producing of a Pulſe of the *Heart* or *Arteries*, the Concoction of *Meats*, *Nutrition*, *Reſpiration* and *Procreation* of *Spirits*; but that they are produc'd without any *Cogitation*, and conſequently that the parts of the *Body* in *Animals* are moved from place to place, in the nature of *Pneumatick* or *Hydraulic Automata*.

LXVII. *Whence the diverſity of motions in Animals, if they have no Soul.*

This hinders not but that the *motions* which are performed by the help of the *Muſcles*, and influx of *Animal Spirits* are various, and not always excited in *Animals*; for example, that *Beaſts* walk ſometimes with a ſwift, ſometimes with a ſlow pace, that they turn this way or that way, *&c.* Since this diverſity of *motions* argues not any Cognition in them, as if they had any deſign in what they did or underſtood, what to Fly from, or what to Follow after, but becauſe they are of ſuch a Conſtitution and Fabrick that the *Pores* in their *Brain* are opened ſometimes one way, ſometime another, and their *Spirits* have a different influx into various *Fibres*, *Nerves* and *Muſcles*, according as the *Organs* are moved by the *Objects*, and ſuggeſt manifold *Species* to them: For example, if a *Dog* be benum'd, or ſeis'd by Cold, or any bad Weather, ſeeing a *Fire* a far off, he makes haſte to come to it, not induc'd by any other reaſon, but becauſe ſuch an Object as that opens the paſſages of the *Brain* which terminate in the *Muſcles* of the *Legs*, and ſo the *Animal Spirits* are tranſmitted to them, which cauſes him to approach near the ſaid *Fire*; and being thus arrived, and finding the kind and grateful *heat* thereof; there ariſeth thereupon ſuch a commotion of *Spirits* in the *Brain*, that immediately they direct their courſe into thoſe *Muſcles*, which is the cauſe that he makes his ſtay there and lays him down to repoſe and cheriſh his benummed *Members*; but if it chance that when he is thus laid, and inclining to *Sleep*, the *Fire* ſhould be over-hot and ſcorching, or a Spark ſhould ſhoot out from a burning Coal, and leap upon his Skin and burn him, this agitation of the ſingeing *heat* immediately opens thoſe Pores of the *Brain* which draw down to the *Muſcles* of the *Neck*, *Eyes* and *Feet*, and attend their *motions*; ſo as that he preſently rouſes himſelf, looks upon the *Fire*, and with a ſwift pace retires from it. Or if the Maſter

of

of the Houſe by chance, from abroad comes home, and comes in view of the *Dog*, immediately upon ſight of him, the paſſages of his *Brain* are open'd, as by cuſtom ſo diſpoſed, in ſo much that he directs his courſe to his ſaid *Maſter*, and teſtifying his *joy* by wagging his *Tail*, fawns upon him. But if a *Stranger* enters, whoſe Countenance and Habit of Body are unknown to him, his Aſpect and unwonted Scent he brings along with him, ſtir up the *Dog* to a contrary motion, by opening thoſe *Muſcles* which attend upon his Barking-fit, and conduce to the warfare of his *Teeth*, and ſtirring up of his Anger; ſo that all the *motions* which are performed by a *Dog*, are excited by *Objects*, which being received into the Senſories, diſpoſe the *Spirits* to an Influx into ſeveral parts of the *Body*, which are adapted and conducible to move them,

LXVIII. *In Man alſo many motions are effected without the concurrence, nay, againſt the conſent of the Soul.*

The *Peripateticks* ought not to be troubled, that we attribute the *motions* of *Animals* to the diſpoſition of their *Organs* only, and make out all their ſenſible *actions* without any help of the *Soul*, when as if they would ſeriouſly inſpect into themſelves, and conſider well what is done within them, they would find the ſame thing altogether in themſelves: For who is there that is not taught by experience, that various *motions* daily ariſe in his *Body* without any concurrence; nay, oftentimes againſt the *Will*, and with the reluctance of the *Soul*? In *Convulſions* or the *Colick Paſſion* ſome part of the *Abdomen* are twitch'd, whence an acute Pain ariſes, the *Bellows* are contracted, and the *Navil* is drawn in: Often-times the *Inteſtines* by an inverſe motion of the *Fibres*, are pulled upwards, the *Ureters* and *Urinary Veſſels* are ſo impelled one againſt the other, that in the whole *Fit*, *Urin* is either totally ſuppreſt, or is voided very ſparingly and by drops: All this while no Man certainly will maintain, that the *Soul* connives at theſe *motions*, when he that ſuffers ſuch grievous *Maladies*, cannot but moſt earneſtly wiſh himſelf free; and there is no Man but muſt vehemently complain of *Pain* during the Contraction, Inflation or Aſtriction. The ſame might be demonſtrated in a world of other Examples, but let theſe few ſuffice, that we may not ſeem to dwell too long upon a thing perſpicuous enough of it ſelf. They that fall down from any high place, fall ſo that their *Hands* come firſt to the *Earth*, ſo as thereby to ſave the *Head*; and this they do not any way conſulting, but becauſe the *ſight* of the impendent fall, reaching to the *Brain*, directs the *Animal Spirits* into the *Nerves* in ſuch a manner as is neceſſary to produce this motion, as it were in a *Machin*. Likewiſe if any one unexpectedly ſhould hold up his *Hand* towards our *Eyes*, as it were offering to ſtrike us, tho' we were ſure of his *Friendſhip*, and well ſatisfied that he did it but in *Jeſt*, and deſigned nothing leſs than to do us a miſchief, yet we ſhould hardly refrain from ſhutting our *Eyes*: Which evidently ſhews, that this ſhutting of them is not any work or deſign of the *Soul*, ſince it is done againſt our *Will*, and our *Will* is the only, or at leaſt principal *action*, but becauſe the *Machin* of our *Body* is ſo compos'd, that the motion of the ſaid *Hand* to our *Eyes*, excites another *motion* in our *Brain*, which draws down the *Animal Spirits* into thoſe *Muſcles* that let down and depreſs the *Eye-lids*. The ſame thing is to be ſuppoſed of other *motions* of the *Body*, for upon the ſight of any delicate or inticing *Meat*, not only the innermoſt *Jaws* are moved with a deſire thereof; but the *Tongue* and *Palate* being moiſtned with *Spittle*, cauſe a certain, as it were *præmanſion* or fore-chewing, as we may ſo call it: So that this ſort of *Meat* is the occaſion that the *Spirits* direct their courſe towards thoſe *Muſcles* which are inſervient to the *Jaws*, *Tongue* and *Palate*, and contribute motion to them. The ſame is to be ſaid of *Itching* and the *Venereal Motions*, which upon the ſight of any *Venereal Object*, are excited in thoſe parts that conduce to the performance of this Scene.

LXIX. *If all the motions of the Body depended upon our Will, there would be no Paralyticks.*

For doubtleſs if all the *motions* of our *Body* depended upon our *Will*, and we could govern our *Members* at pleaſure, there would certainly be found no Paralyticks, or Perſons troubled with a *Palſie*; none deprived of *motion* all the *Body* over, or in any of its parts. Foraſmuch as there is no Man, in whom there is not a *Will* to move his own *Members*, and free himſelf from that reſolution or untying of the *Nervous Parts* which takes away *Senſe* and *Motion* from him. Who would ſuffer the uſe of any of the parts of the *Body* to be taken from him, if it were in his power to open the Obſtructed Paſſages, and make way for the *Animal Spirits*, by which they may be tranſmitted, and may influence, plump up and actuate with vigour the *Nervous Parts*?

LXX. *There are alſo certain ſpontaneous Motions without Deſign or Will.*

Now there are not only *Natural Motions* which are performed in us without the help of our *Knowledge* or our *Will*; but there are alſo a world of thoſe which they call *voluntary* or *ſpontaneous Motions*, which are effected by the diſpoſition only of the *Machin* of the *Body*, without any thought or deſign contributed thereunto by our *Soul*: For if, while we think upon any other *thing*, a *ſpark* of *Fire* chances to light upon our *Hand*, we preſently ſtart back with all imaginable ſwiftneſs, there needs no deliberation for ſo doing, our *Will* not being concerned in this *motion*, our *Hand* is drawn back before we can have ſo much as a thought thus to ſnatch it away.

LXXI. *Of motions made to hinder us from falling.*

If we have a mind to *ſtoop* for the taking up of any thing upon the *Ground*, we draw back one *Leg*, ſo to give us the better advantage to counterpoiſe the reſt of the *Body*, which hereupon leans forward: If *walking* upon a dangerous path, we chance to *ſlip*, we immediately lift up that *Arm* which is oppoſite to the place where our Body juſt before inclin'd upon its fall, and by this means we give a ſtop to the force of the fall, and ſuſtain our ſelves the better, in regard the *Arm*, thus lifted up, keeps off its whole weight from the middle of the *Body* where the *center* is; and by this enlightment gains ſufficient force to counterpoiſe the reſt of the *Body* which inclined on the other ſide; as we ſee that in a *Ballance*, a ſmall weight hung at a diſtance from the Center thereof, holds an *æquilibrium* againſt another far greater which is nearer the *Center*.

LXXII. *That motions proceed not from any Cognition or Knowledge.*

And this we learn'd when we were but *Infants*, that *weights* far diſtant from the *Center*, have always ſo much the more force, and that the *Arm* lifted up hath the more power to ſuſtain the *weight* of the *Body* when it begins to fall, and that the *Center of gravity* muſt be always under our *Feet*. But tho' we practiſe all theſe *Rules* with the ſame ex-

exactness as the most able *Philosophers*, all the reflexions we make upon the Laws of *Motion* and of *Æquilibrium* are useless and unprofitable in the Practick, and so far are these *Sciences* from being able to serve us upon any occasion, that they would be rather very prejudicial, were we minded to make use of them; since certain it is, that we perform better all these *motions* when we think not on them, than when we are intent upon them. We must therefore of necessity acknowledge, that whatever is acted in us, is without our *knowledge*; at least that *knowledge* we have sometimes by *reflexion*, is not at all the cause, since these *motions* prevent us in our *thoughts*; and these *thoughts* imployed about them, rather hinder than help us. If then these *motions* so regular, so proportioned to their *performances*, so conformable to the *Laws* and *Rules* of the most refined *Philosophy*, can be performed so effectually and to the purpose in Man without any *Cognition* or *Knowledge*, how comes it that *Brutes* act by *Knowledge?* And why should it not rather be generally allowed what we maintain, that they are able to act by the disposition of the *Machin* of the *Body* only, according as we act by the like disposition of ours?

LXXIII. *How improperly some Physitians speak, who attribute certain Passions to Nature.*

How unaptly and improperly do some *Philosophers* and *Physitians* speak, tho' seeming to utter *great things*, when with a *Magisterial Countenance* they pronounce that *Nature* abhors a *Vacuum*, and shews an aversion to what is disagreeable to her; that a *Medicin* chooses what Humours to attract, and passes by and leaves untoucht others; *Nature disposes* her self to a *Crisis*, as to a Combat; that she *indeavours* to *subdue* or *throw* off the Hostile Matter of the Distemper, that being vanquish'd, she is reduc'd as it were to *desperation*, and as it were throws away, or lays down her *Arms*. By which *ways* of *speaking*, they do but fly to a pretty handsome way of concealing their *ignorance*; and that they may not seem to be put to a nonplus, and have nothing to say, they attribute to *occult Effects*, some, tho' no less *Cause*. Because, since *Appetite*, *Election*, *Will*, *Hatred*, proceed from our *Mind*, and are no other than various *modes* of thinking; we could not but be conscious of them, if they were found in us. But since we neither have a *Will* or *Aversion* to any of those things aforesaid, to which these *motions* tend, nay, are ignorant after what manner they are effected; they must maintain that these sort of *motions* are not found in us, or if they are found, that they have the *Body* only, that is, the disposition of the *Organs*, and influx of *Animal Spirits* for a *Principle*. Which how absurd it is to assert, no Man in his *Senses* can be ignorant, who knows that the *Mind* is distinguish'd from the *Body*, and that the ways of each are different one from the other. Otherwise what have we to do but to agree with the most Illustrious *Verulam*, That to all *Bodies*, of whatsoever quality, destitute of *Sense*, there is inherent a certain faculty of perception, if it be true, that when *Body* is applied to *Body*, there may be deprehended in them *something very Analogous and Cognate to Election, in admitting things agreeable, and excluding or rejecting things ungrateful.* What should we do, but allow *Cognition* to *Plants*, if some of them contract a friendship with others, and covet some parts of the *Earth* to harbour in more than others, and make choice to themselves of what *Aliment* is most agreable to them? And if others on the contrary fly so much as the touch of Neighbouring *Plants*, are pleased with a *sandy* or a *plashy Soil*, one more than the other; and several of them have an abhorrence, some of *Cold*, some of overmuch *Heat*? What should hinder us from believing that the *Stomach* is indued with *Understanding*, if it discerns what is hurtful, from what is wholesome, and hath an Appetite to things only agreeable to it, and having taken Poison, is provoked to Vomit? For these *actions* belong to the *Soul*, and that thing must needs be indued with *Cogitation*, which *loves* and makes *choice*, which hath an *aversion*, which hath an *abhorrence*, which is delighted with one thing more than another, and hath an *Appetite:* So that I can by no means agree with the most Famous *Harvey* in his Opinion, that all parts of the *Body*, which by their own *motion* strive against *provocation* and *injuries*, injoy a certain *sense* by which they are impelled to *motion*, and consequently that the *motions* and *actions* which the *Physitians* call *Natural*, are not performed without *Sense*; and that there is a certain *Latent Sense*, by which they are excited, provok'd and altered; for were it so, we must consequently acknowledge that the *palpitation* of the *Heart*, *trembling*, *fainting fits*, *swooning fits* and alterations of the *Pulse* in *Magnitude*, *Celerity*, *Order* or *Harmony* which proceed from *Morbifick Causes*, altering and hurting the *Sense*, are indued with *Sense*.

LXXIV. *Nor less improperly they who attribute Sense to Brutes.*

Nor am I more inclinable to the Opinion of the *Peripateticks*, who *attribute Sense* to *Brute Animals*, and are perswaded that they *See*, *Hear*, *Smell*, &c. in the same manner as we do; which certainly no Man will allow, who forms to himself a true *Idea* of *Sense*, and hath attain'd so much *Judgment* as to understand what is included in the *Notion* or *Conception* of it; forasmuch as *Sense* is not distinguished from *Cogitation*, and is applicable to a *thing Spiritual* only and *Incorporeal*, from which it cannot be separated. Hence *Hippocrates* in his *Sixth Aphorism*, and *Second Section*, *They, who being agrieved in any part of the Body, yet feel no pain, their Mind is certainly sick.* If therefore they are not sensible when the *Mind* is *sick*, so as not to be intent upon the *Organs* of the *Senses*, much less can any other *Creature* be sensible of those things which beat upon the *Sense* less violently, unless the *Mina* be present; as we also find by experience in our selves. For it very often happens, that we run over with our *Eyes* the *Letters* of any *Writing*, and that our *Ears* are smitten with the *sound* of *Words*, tho' we neither *understand* nor *perceive* either the one or the other, because our *Mind* is set upon certain *things*, each of which nevertheless afterwards returns, and is represented to our *Cogitation:* If therefore Men who are indued with *Mind*, when they attend not, but are imployed elsewhere, are not sensible, much less can *Animals* be sensible, who are *Senseless* and destitute of *Mind*. So that *Plutarch* rightly concludes in his Book *De Sagacitate Animalium, Mentem tantum videre & intelligere, &c.* That the *Mind only sees and understands*, and that *all things else are surd and blind, in regard the passion of the Eyes and Ears, when they are smitten by Objects, stirs up no Sense, if the Cogitation of the Mind be absent.*

Nor

LXXV. *Aristotle's Opinion, that Mind only is sensible.*

Nor do *Aristotles* own words, *Section I I. Problem* 33. make less for our *business*; for the *Philosopher* having made an inquiry, why *Night* is more accommodated for *hearing* than *Day*, after he had quoted *Anaxagoras* his Opinion, who judged the reason to be because the *Air* in the *Day* time, heated by the *Sun*, hisses and makes a Noise, but by *Night* is silent and at rest, the *heat* being then gon; goes on with his Discourse in these words, *Quoniam Corpora interdiu, &c.* because *Bodies* by *Day*, variously divide and disperse the force of *Understanding*; and put it upon divers *operations*, so that the *sense* of *hearing* plain is taken away; and by reason we act and manage all things more by *Day* than by *Night*, the *Intelligence* it self is hindred and interrupted by the affairs of the *Body*: But *Sense* when it is separated from *Intelligence*, is upon, as it were, an insensible *work*; whence that saying, *Mens videt, Mens audit*, the *Mind* sees, the *Mind* hears; that is, perceives *Objects* which smite the *Organs* of the *Body*, for no other things are thus perceived by the *Mind*; whence it follows necessarily, that those things which are void of *Mind*, are also destitute of *Sense*.

LXXVI. *The Vulgar Objection to shew that there is Sense in Animals.*

But some will start up, and cry out against this *Opinion* as Cruel, and will call it the utter extirpation of *Animals*. What, will they say, will you deprive all *Animals*, not only of *Intelligence*, but also of all *Sense*? O Barbarity! What can be more oppugnant to Experience, and the common Opinion of all Men? Do we not daily behold *Beasts* coming nearer and nearer to perfection, *looking seriously* upon visible *Objects*, and *receiving sounds* in at their *Ears*, by which *sounds* they are excited to *Labour*, to the running of *Races*, to *Meat*, to *Drink*, and other such like *actions*? who knows not that a *Cat*, *Dog* or *Ape* distinguish their *Food* by *smelling*, and hunt after that which is agreeable and grateful, and fly and eschew that which is ungrateful and noxious? How can it be that a *Spider*, sitting in the midst of his *Web*, can feel when a *Fly* is intangled in the remotest part, and yet be destitute of the *Sense* of *Touching*?

LXXVI. *Sense is to be distinguished by three degrees.*

Our business therefore is to shew, for what reason we exclude *Sense* from *Beasts*; and how it comes to pass, that they have *Eyes*, yet *see* not; are provided with *Ears*, yet perceive no *sounds*; are not without a *Nose*, yet *smell* not; have the use of a *Tongue*, yet *discern* nothing by any different *relish* or *Savour*; which the better to effect, we propose a thing Note-worthy; that our *Sense* is to be distinguish'd into three degrees. The first *degree* contains that *simple motion* which the *Object* impresses upon the *Nerves*, or that whereby the *Organ* of the *Body* is immediately affected by external *Objects*, which can be nothing else but the *agitation* of the *particles* of the said *Organ*, the change of *Figure* and situation proceeding from this *agitation*: For *Sense* consists in *Motion*, and as *Aristotle* asserts in his Third Book, *De Animalibus*, Chap. 13. *no motion can be had without contact*. So that a *Corporeal Organ* must needs be touch'd after a *Corporeal* manner, and *motion* must needs be impress upon *sensible things*. When, I say, that the *motion* of an *Object* is impress upon a *Corporeal Organ*, I would not have it understood that the *motion*, for example, of the *Eye*, is only made there, but that it passes up to the *Brain*, from whence the *Fibres* of the *Nerves*, like *Lute-strings* in a *Lute*, are stretcht out to other *Members*. The *Second Degree* contains *Perception*, which is tied to that *motion*, whenever this impression is carried to the *Pineal Glandule*, or seat of the *Soul*. Such are the perceptions of *Pain*, *Titillation*, *Thirst*, *Hunger*, *Heat*, *Sound*, *Savour*, and the like; which, we say, arise from the *substantial Union* of the *Soul* with the *Body*. The Third contains all those *Judgments* which attend those *Perceptions*, that is to say, those *Judgments* which, from the very first we have ever used to make of things without us upon occasion of the *motions* of a *Corporeal Organ*. Or to comprehend these three Degrees of *Sense* in fewer words. The first Degree is the *affection* or *motion* of a *Corporeal Organ*: The second the *perception* of that impression which is proper to a *Corporeal Organ*: The third the *determination* of *Judgment* to affirm, or deny any thing. And still to render the matter a little more plain, when any one beholds, for example, the *Moon*, the *Corporeal Organ*, that is to say, the *Eye* is moved, or affected by the *Light* which is reflected by the *Lunar Body*; and herein consists the first Degree: The Mind presently perceives the *Light* or *Colour*, and this is the effect of the second Degree. Moreover the *Mind* assigns *Colour* to the *Moon*, that is, delivers its *Judgment*, as asserting that the *Moon* is *coloured*, and this is the result of the third Degree.

LXXVIII. *How Sense may be applied to Brutes.*

These things thus premised, it manifestly follows, that *Animals* are void of *Sense*, properly so call'd, unless we admit for *Sense*, that *Corporeal Motion* which preceeds *Perception*, and hath reference to it, as to something begun and imperfect. For it is of *Corporeal Motion* only that *Animals* are capable; nor do we deprehend any thing to be in them, which can persuade us that they are sensible, if the word *Sense* be taken for any other than the impression of the *external Object* upon the *Organ* of the *Senses*: So that those persons that think the *motion* of a *Corporeal Organ* deserves the name of *Sense*, are no less absurdly persuaded, than they who maintain that the *Optick Cubicle* sees while it receives the *Species* of *external Objects*, and represents things done without. That the *Eye* of a slain *Ox* sees wherein all things are distinctly delineated, no less in than the *Retin* or *Network Tunicle* of a surviving *Ox*. That *Men see*, who, like *Hares sleep* with their *Eyes* open; and cannot be discern'd to be *awake*, any otherwise than by the loosning of their *Eyelids*. When as the *Optick Chamber*, the *Eye* of the *dead Ox*, the *Retin Tunicle* of a *sleeping Person*, receive the *Species* of *external things*; and in the same manner as they represent the *Picture* of *Objects*: So that if *Corporeal Motion* be allowed to injoy the name of *Sense*; by the same force of Reason it may be inferr'd, that it may be attributed to *Inanimate Things*.

LXXIX. *Sense consists not in the motion of a Corporeal Organ, but in Perception.*

But I can easily imagin what may be objected against this *Ratiocination*; namely, that a *Body* is the *Instrument* of *Sense*, whose *action* must needs intervene to our *Sensations*, and consequently that for producing of *Sense*, there is required an *Organ* disposed after a certain manner; that is to say, into which the *Animal Spirits* may flow, and whose *motion* may reach up to the *Brain*, which without *motion* cannot be done. All these *Conditions* I willingly grant, and I confess it is requisite for the making of us sensible, that an *Organ* be

modified by certain *diſpoſitions*; but I only inſiſt, that neither the *action* of an *external Object*, by which the *Organ* is moved and diſpoſed; nor the *mutation* of *Figure* and *Situation*, which promotes that *Action*; nor that *tranſmiſſion* which is made to the *Brain*, are *Senſes* or *Apprehenſions*; but that which immediately reſults in the *Mind*, which is joined to the *Corporeal Organ*, ſo diſpoſed: For how can that ſaying of the Prophet *Iſaiah* be underſtood, *In hearing ye ſhall hear, and ſhall not underſtand; and ſeeing ye ſhall ſee, and ſhall not diſcern:* Unleſs the firſt degree be ſuppoſed to be diſtinguiſhed from the Second, and that *Corporeal Motion* may be disjoined from *Perception*, or attention of *Mind*.

LXXX. *Corporeal Motion may be had without Senſe.*

But what need is there to have recourſe to *Holy Scripture*, to prove *Perception* to belong to the eſſence of *Senſe*; and that the *work* of the *Mind* is required to be concerned, when we are ſaid to *hear*, *ſee*, *ſmell*, &c. ſince we find it not ſeldom by experience in us, as namely when the Mind being very much taken up in *contemplating* other things, a Man may paſs by us, and not be taken notice of, tho' our *Eyes* be open, and directed towards him, there being no obſtacle in the way to hinder; and ſo likewiſe not obſerve his *Speech*, tho' our *Ears* be open, and immediately take in *ſound*; We may alſo not *taſte* the reliſh of *Meat*, tho' the *Fibres* of the *Tongue* be ſmitten by the *Corpuſcles* of the *Meat*; and the whole plexure of the *Organ* be never ſo clean, and void of all clog or impediment: Laſtly, we may be exempted from the *pain* of *Cold*, tho' in a rigid *Climat*, and the *Air* ready to *freez*, through the bitterneſs of the *weather*. All which things ſufficiently prove, that not the *Members* or *Organs*, but the *Mind* only do *ſee*, *hear*, *taſte* and *feel*.

LXXXI. *How thoſe are miſtaken, who from external actions judge Brutes to be ſenſible as we are.*

Whence it is apparent how fooliſhly thoſe perſons reaſon, who becauſe they obſerve *Brute Animals* to be mov'd by the *Species* of *external things*, and to feed as Men do on *Meats* offer'd them, to be affected with *ſounds*, to be taken with the aſpect of ſome *Objects*, and *frighted* with that of *others*, preſently infer that *Beaſts* alſo are ſenſible; that is, that they think and give attention to any thing that is offered; whereas indeed all thoſe *motions* in *Animals* are performed without any concurrence of the *Soul*, and only effected by a blind impulſe of *Organs* and *Animal Spirits*. This error hath grown up with us from our *Infancy*, as *Claubergius* obſerves in his *Prolegomena Logicæ*, by reaſon that at that time, and in that very moment, in which our *Corporeal Organs* were moved by *external things*, the *Mind* joined to the *Body* had ſtill a perception of ſome thing, and ſo we taking both for one, attribute perception to the *Corporeal Organs* of the *Senſes*; which the Wiſe attribute only to the *Intellect* or *Underſtanding*. Hence we ſay generally by way of familar *ſpeech*, that the *Eye ſees*, that the *Ear hears*, that the *Tongue taſtes*, that the *Noſe ſmells*, that the *Hand feels*; nay, which is more, becauſe whilſt the *Body* was affected with *external things*, the *Mind* alſo perceived ſomething, and thereupon preſently made a judgment of ſomething; hence we aſcribe *eſtimation* and *judgment* to *Corporeal Organs*, to which nevertheleſs the *Philoſopher* knew well enough that *Body* is not deſired, but that beſides the apprehenſion of the *Intellect*, the aſſent of the *Will* is alſo required. For juſt as it often happens in other things, ſo doth it alſo in theſe *Acts* of *Underſtanding*, *Imagination*, *Perception* and *Judgment*, namely that they are often taken one for the other, and confounded together, and only for this reaſon, becauſe they exiſt together at the ſame time. So becauſe whilſt the *Eye* is moved by the *Light*, the *Mind* alſo joined to the *Body* perceives ſomething, and at the ſame time judges; therefore theſe three different things, *viz.* the *motion* of the *Body*, the *perception* of the *Mind*, and the *judgment*, are all taken by the Vulgar for one and the ſame thing, and are all expreſt by that one term of *Seeing*, as when they ſay *I ſee the Sun.* But the *Wiſe* are far above this manner of *ſpeaking*, as well knowing the difference between that which, in our *ſenſations* belongs to *Body*, and that which belongs to *Mind*; for the *motion* which an *external Object* impreſſeth, and the *mutation* of *Organ* belongs indeed to *Body*; but it comprehends no *Perception* or *Cogitation* which is proper to the *Mind*, and from which it cannot be ſeparated.

LXXXII. *According to* Plato *there is no Senſe but from the Soul.*

This Opinion *Divine Plato* maintains in *Marſilius Ficinus*, in his *Argument* againſt *Thetætus*: *We muſt note*, ſaith FICINUS, *that* Plato *allows no Cognition to Body, as likewiſe no Life: That which lives, is ſenſible; the Soul lives, and the Soul is ſenſible; but in the Body there is neither Life nor Senſe; yet the works of Life and Senſe are viſible in it. So that thoſe which ſome call the Five Senſes, he will have to be called the Five Organs of Senſe, and aſſerts that nothing hath any ſenſibility by theſe Inſtruments, but that through theſe, as it were, paſſages, each part of Senſe is performed by one certain force of the Soul, which operation he calls the Common Senſe; into which various paſſions have influx as Lines from the circumference to the Centre of a Circle. Colours*, through the *Eyes*; *Sounds*, through the *Ears*; *Odours*, through the *Noſe*; *Savours*, through the *Tongue*: Laſtly, *heat*, *cold*, *moiſt*, *dry*, *grave*, *light*, *ſoft*, *hard*, *ſmooth*, *rough*, *rare*, *denſe*, *acute* and *obtuſe*, through the whole *Body*. That this *Soul* is ſenſible, not by many, but by one *power*, is apparent, ſince when we feel *heat*, we do not give this *Senſe* the appellation of *Voice*; nor when we perceive any thing of a *Savour*, do we call it *Odour*. He cannot diſtinguiſh one thing from another, who knows not both. No one *Organ* performs the ſame things as another doth; or if the ſame things, not in the ſame manner; ſo that the diſtinction of thoſe things which are perceived is not in the *Organs*, but in one certain power of the *Soul*, perceiving each thing, and diſtinguiſhing all things one from another. All which, ſince the *Soul* alone is able to effect, as the *Peripateticks* themſelves cannot deny, what need is there of many *Senſes*.

LXXXIII. *Corporeal Organs perceive nothing.*

From which words of *Plato*, we may thus argue: If *Senſe* reſided in a *Corporeal Organ*, it might be ſaid the *Eye ſees*, or the *Ear hears*; but according to *Plato*'s Opinion, neither the *Ear hears*, nor the *Eye ſees*; nay in the *Body*, there is neither *Life* nor *Senſe*; only by it the works of *Life* and *Senſe* are made to appear: And it is the *Soul* as *Marſilius* ſaith in another place, which is in *pain* or *rejoiceth*, not the *bulk* of the *Body*; conſequently there is no *Senſe* in a *Corporeal Organ*.

From

From hence also it is clearly to be deduc'd, that *Brutes*, since they are void of *Mind*, and have nothing but *Corporeal Motion*, do not, for example, *see* like us, that is, as being sensible, or taking notice that they *see*, but only as we do when our *Mind* is elsewhere imployed, or called aside, tho' the *Images* of *external Objects* are painted in our *Retin Tunicle*, and perhaps also their impressions being made in the *Optick Nerves*, dispose our *Members* to different *motions*; yet nevertheless we perceive nothing of them: In which case it appears also, that we are moved no otherwise than as *Automata*, as hath been already declared by several Examples.

LXXXIV. *For what reason Animals are said to have five Senses.*

Wherefore if all the Freaks of the *Brain*, and all the *motions* of the *Animal Spirits*, which are caused by the *Nerves*, must needs be called *Senses*; it may be said that *Animals* have five exterior *Senses*, because there are five sorts of *Nerves* which convey the impressions of *Objects* to the *Brain*, and which dispose the *Animal Spirits* to insinuate divers ways into the *Muscles*, for the moving of the *Members*: Hence it is, for example, that *Animals* are said to *see*, when the *Light* enlightens the *Optick Nerves*, and by them the parts of the *Brain*, from whence they have their *Original*; that they *hear* when the *Air* which hath been smitten by any resounding *Body*, strikes upon the *Nerves*, which terminate in the *Ears*: That they *taste* when the *particles* of the *Viands* which they chewed, have force enough to enter the *pores* of the *Tongue*, and so excite the *Nerves*: That they *smell* when the most subtile parts of the *Body* which they inviron, being mingled with the *Air*, which causes *Respiration*, hit against the *Nerves* that terminate in the *Nose*; and that there is simply a *Sense* of *Feeling*, when any exteriour object is immediately applied to some part of their *Body*, and have force enough to agitate the *Nerves* which there terminate. It is said likewise that they have *Sense* of *Pain* when the *agitation* of the *Nerves* is very violent, and that they have relaxation of *Pain*, when this agitation is indifferent; but all these *sentiments* are nothing else but the power which the *Animal Spirits* have to be disposed by the presence of *Objects*, to pass through the *Brain*, and through the *Nerves* into some certain *Muscles* rather than others; and by consequence that there are no *Senses* but according to the first degree, that is to say, that they have none but *Corporeal Motions*.

LXXXV. *Dr. Willis his Opinion about the Cognition of Brutes.*

The Famous Dr. WILLIS in his *Exercitation* concerning the *Soul* of *Brutes*, where he acknowledges a *Corporeal Soul* in *Brute Animals*, and fancies it to be of an *igneous* or *fiery Nature*, and of kin to *flame*, thinks it no absurd thing that there should be allowed in *Animals*, a power to speculate and discern the *Images* of sensible things delineated in the *Brain*, and to draw forth, according to the impressions there conceived, *Appetites* and respective *Acts* of other Faculties. In regard tho' the *Soul* and *Body*, taken apart may not have the same power; yet this hinders not, but that from a certain Law of the *Creation*, as he calls it, or Institution of *Almighty GOD*, an *animated Body* may be so disposed, that from *Soul* and *Body* joined together, there may result a *confluence* of such sort of *faculties*, as shall be needful for every *Animal*, for the ends and uses designed it. In many things framed by *Human Art*, the *Workmanship hath exceeded the Materials*, as who would think that of *Iron* and *Brass*, the most fixt and unactive of *Metals*, an *Instrument* should be composed, whose *Orbs* imitating the *Cœlestial Orbs*, should observe *motions* little differing from perpetual, whose *periods* renewed by a constant vicissitude should most certainly measure the spaces of Times? No wonder that from a *Wind* blown into a *Pipe*, a rude and simple *Sound* should be produc'd, but that from a *Breath* infused into *Musical Organs*, and so variously transmitted through manifold apertures of *Valves*, or stops into such and such *Pipes*, a most grateful harmony should arise; this, I say, we cannot but admire, and confess withall, that this effect far exceeds, as well the matter of the Instrument, as the Hand of the *Musitian playing*, tho' the *Musical Organ* require for the most part the skill of the said *Artist*, by whose direction the *Breath* admitted, now into some, now into other *Pipes*, performs manifold *Harmonies*, and almost an infinite variety of *Moods*. So in some *Brutes* of the more perfect kind, whose *Actions* are ordained for many and more noble uses, there ought to be attributed a certain faculty, that is, the *Brutal Soul* it self, naturally so endowed, as to be rendred knowing and active about some things necessary for it, by various accidents with which it uses daily to be affected, and afterwards is taught to know other things, and to exert far more, and more difficult *Actions*,

LXXXV'. *Dr. Willis his Opinion concerning the knowledge of Brutes disputed.*

This similitude I easily admit, as from which much *Light* is added to the foresaid *Reasons*, demonstrating, that *Brutes* are meerly *Machins*, which act according to the Laws ordained by the *Creator*, and after the manner of a *Musical Instrument*, which by a *touch* or *breath* infused, produces most admirable *Harmony*: Forasmuch as by the circuit of the *Blood* through the whole *Body*, they effect all their *motions*. But still I am not able to comprehend how from the *union* of two material, and consequently insensible *substances*, *sense* and *perception* should arise: For however in *Machins* the Matter is exceeded by Art, and from the mixture of divers *Metals Instruments* are framed for wonderful performances, yet this argues not that Matter can ever be brought to that perfection, as to be apprehensive of things that occur to them, and to be sensible that they apprehend them. But suppose that by a certain Law of the *Creator*, there may be attributed to a *Body* instructed with *Organs*, and designed for certain uses, some power of sensibility, which cannot belong to *Body*, nor *Soul* taken apart, but only to a compound resulting from both. Yet by the leave of this most Learned Man, I would gladly know what that Principle of Sensibility is, whether some substantial Mode, by which a *thing Animate* is differenc'd from a thing *Inanimate* and insensible, by the access whereof an *Animal* is constituted? But nothing is found in an *Animal*, which can distinguish it from things *Inanimate*, excepting the *Blood*, which by an incessant Motion, is impelled into the *Veins* and *Arteries*, to nourish the parts of the *Body*. Now what activity is there in the *Blood* that it should impart sensibility to the *Body*? Is there haply a certain *Universal Soul* coævous to Matter, which actuates it, and brings it to perfection, according to its various dispo-

dispositions? This being granted, who will not see a necessity, that then not only *Animals*, but *Plants* also and *Stones* must have *Sense*: Forasmuch as that active and Energetick Power, by the same right may as well be infused into them by the great Founder of *Nature*; or is it some Principle Emerging from *Soul* and *Body* joined; by which an *Animal* is rendred capable of knowing the impressions of *Objects*? Surely whatever this Principle may be fancied to be, since it must need be *Material* and *Extense*, it cannot be indued with the power of *Acting*, *Thinking*, *Perceiving* and giving *Intention*. For it is not to be understood, how from *insensible things*, another *thing* should arise which is *sensible*, and *perceptive*? By what means a *corporeal thing* should produce *spiritual Acts*; and that which is *extense*, should bring forth that which is void of all *extension*?

LXXXVII. *The Idea of Local Motion is something distinct from the Idea of Cognition.*

But if this most famous *Author*, while he allows a Principle of *Cognition* to *Brute Animals*, means that their *Cognition* is nothing else but the reception of a *material Species*, or a various motion of some interiour part of the *Brain*, we give our *Hand* and subscribe to his Judgment; since we acknowledge and confess, that these sorts of different *motions* in *Brutes* are affected by various impressions of *Objects*. But we can by no means be induc'd to grant, that the *Idea* of *Local Motion* agrees with the *Idea* of *Cognition*, or that the *Perception* and the *Motion* of a *Corporeal Organ* are not distinguish'd from each other, in regard since *Body* and *Mind* are totally different in their kind, and the distinction which is between the *mode* of one *Substance*, and the *mode* of another *Substance*, is real; it must needs be that the difference between *Perception* and the *Motion* of a *Corporeal Organ* is equal, and consequently that they cannot both proceed from the same Principle.

LXXXVIII. *If Brutes should have Knowledge, they would exceed Men in Perfection.*

Haply, for this cause some of the more Modern *Philosophers* deny rationality and discourse to *Brutes*, as being inconsistent with *Material Organs*, since they judge *Beasts* uncapable of beholding any thing with reflection; yet cannot persuade themselves, that they do not perceive, so long as they behold *Objects*. What, say they, shall they behold *Objects* with their *Eyes*, receive *Sounds* into their *Ears*, and yet not conceive these different *Species* or *Images* painted in some part of the *Brain*? What should hinder, but that as there is allowed a double *Memory*, one *Sensitive* the other *Intellectual*; so in like manner, there may be supposed one *Sensitive Perception*, another *Intellectual*? To this, besides what hath been already urged in some former *parts* of this *Discourse*, there needs no other answer, but to affirm, that by admitting such a Perception in *Brutes*, they grant them a degree of Perfection equal to that of *Men*, if not greater: For wherein do they imagin *Sense* to be distinguish'd from *Reason*? Doubtless herein the *Cognition* is apprehensive of *Sense*, and *simple*, therefore not obnoxious to falsity: whereas the *Cognition* of *Reason* is a little more *Composite*; and it may be made out by the conclusions of *Syllogisms*, that it seems no way to argue a greater perfection, especially since they affirm the *Cognitions* of GOD and of *Angels* to be most simple, and only intuitive or apprehensive, and perplex'd by no intricacies of Discourses; so that by them, if we may so say, the *Sense* of *Animals* comes nearer to the *Cognition* of GOD, and of *Angels*, than Human Reason.

LXXXIX. *There is a Sensitive Memory to be found in Beasts.*

As to the *Sensitive Memory*, or memory of *material things*, we easily allow it to *Beasts*, since it is fixt to a *Corporeal Organ*, and depends upon the *Vestigia* or footsteps remaining in the *Brain* after some Image had been impresst upon it; forasmuch as those *Vestigia* are no other, as I have at large made out in my *Institution* of *Philosophy*, than certain Paths, which the course of the *Animal Spirits* hath left among the *Fibres* of the *Brain*, through which at first they passed, in the same manner as *folds* in *Paper* or *Linnen* render the said *Paper* or *Linnen* the more apt to readmit the same *folds* as before, I say more apt than if no *folds* had been made there; whereby it comes to pass, that the *Fibres* of the *Brain* are indued with a Power of attracting and disposing the *Spirits*; so that the next time they may have egress through the same *Vestigia*, in the same manner as they had egress the first time. So that this sort of *sensitive memory*, consists in the disposition of the parts of the *Brain*, induc'd from the *Objects* through the *Senses*. Which disposition, if it happen to be inverted, or destroy'd, the *Memory* immediately must of necessity be either weakned or utterly perish: As may be proved by many examples in those, who either by the blow of a *Stone*, or by the sharpness of some *Distemper*, or by a fall from a high place, have lost the use of their *Memory*, forgetting all those things which they knew before. See the *Natural History*, the last *Part*. Nay some there are who have had the *Vestigia* of their *Brain* so far disturb'd by the overmuch taking of *Tobbacco*, as to abolish all signs of things, and to overthrow the *Characters* long since there impresst. Whence it is plain that the *Memory* is a *Corporeal Faculty*, which by the *Vestigia* which it conserves from the *Species* of *Objects*, hath a power of exciting those *Images* anew, and of procreating the *Idea's* of things formerly done.

XC. *Divers Brutes are void of the Intellective Memory.*

Nothing therefore hinders, but that *Animals* may remember,

And mindful Goats unto their Huts return.

(as *Virgil* hath it in his *Georgicks*) while the Images of *Corporeal Objects* recur in the same order as they entred the *Loculi* or *Cells* of the *Brain*, and stir up the same kind of *motion* in their *Nerves*. Yet all this while they do not perceive that they remember, nor do they, neglecting other things, make any choice of what they chiefly have need of, nor search after new things, nor call to mind former configurations, but act after the manner of *Minstrels*, who play upon the *Harp*, touch the *Chords*, and produce various sorts of *Harmony*, without any care or heed to what they are about. So the *Dog Argus* knew, and fawned upon *Ulisses* after his twenty years travel. So the *Birds* flying out of their *Neasts* for food into the *Woods*, return from a far off: So *Fishes* upon *signs* given, run to the *Meat* thrown them in their *Ponds* and *Lakes*, and afterwards retire to their *holes*: So the *Wild Beasts* return each to their *Dens*, tho' far apart, and by their *Scent* find out their way when-ever they chance to lose it. Because the *Animal Spirits*, finding the *pores* of the *Brain* through which they for-

formerly began their course, enter them more easily than others, by which means they excite a special motion in the *Glandula Pinealis*, whereby the same Object is again represented to them; haply for want of these *Vestigia*, the *Tucani* are indued with little or no *memory*, in so much that going out of their *Den*, they know not the way in again, but are forc'd to dig another to repose in.

The Second Part.

A DISSERTATION Of the want of SENSE AND KNOWLEDGE IN BRUTES.

I. *The order of things to be declared in the Second part of this Dissertation.*

ALTHO' it hath been made out by Reasons strong enough, that *Brute Animals* are destitute of *Sense* and *Perception*, and that nothing of *Cognition* is to be discern'd in their Operations, and consequently, that a well-contrived *Structure* of the *Members*, and a precise direction of *Animal Spirits* through certain *Passages*, must needs be the Principle of all their *Actions*; yet in all this we cannot pretend to have done any thing to the purpose, unless we descend to particulars, and make it appear, that all the *Actions* of *Animals* may be *mechanically* demonstrated, and that the *motions* which we think proceed from a certain *Soul* in *Beasts*, are of kin to those which are produc'd in *Automata*, by virtue of a Spring, and disposition of *Wheels*. It is indeed a difficult Labour, yet nertheless necessary to be undertaken, if we intend to bring the Work begun to its desired end, and make a solid superstructure to the foundations we have laid: But the better to observe a certain Order and Method in this Second Part of this Dissertation; we judge it expedient to reduce all the *Operations* of *Brutes* into Five Classes or Ranks. The First of them is those which are inbred in *Beasts*, to the exercise whereof they are carried by a certain innate force. The Second is of some *Actions*, which argue a sort of Craft in them, and bear some signs or semblance of *Intellect*, *Judgment* and *Discourse*. The Third is of those which insinuate the docility of *Animals*, and their aptitude to be instructed; implying that something of Reason shines in them as well as in us. The Fourth is of *Actions*, which discover a kind of *Mutual Speech* in *Animals*, and which seem to make a kind of necessity of allowing the use of *Language* common with us. The Fifth and Last is of some *Actions*, by which *Animals* seem to excel the cunning and sagacity of *Men*, and that there is peculiar to them a Providence, and Foreknowledge of things to come, above what falls to *Mans* share and lot to be indued with.

II. *Some Operations of Beasts produc'd by Natural Instinct.*

As to the First it is evident, that there are *Actions* proper to every *Species* of *Beasts*, and that they are so determined to certain *Operations*; that they all design and perform the same thing without any difference. CAMELS fly from pure Streams, and hunt after muddy and troubled Waters, in so much that when ever they go into a *River* to *drink*, if the *Water* be not muddy, they raise the Mud by a vehement scraping on the Ground with their *Feet*. CONIES continually dig themselves *Burrows* to lodge, and cover them with Sand, that they may not lie open, and be exposed to the rapines of the *Ferrets*. HARTS shot in their Side with a Dart, presently seek after the Herb *Dittany* for the curing of their Wound, and expelling the Pain with which they are afflicted. If the Root of *Valerian* be thrown before CATS, they run to catch it, they lick it, make much of it, and like Persons Dancing and Skipping, they run about and discover many signs of *Joy* and *Pleasure*. A HEN at the

sight of a *Kite* makes a *clocking*, and as it were exhorting her *Chickens* to flight, she still advances her *Voice*, and calls them under her *Wings*.

III. *The same Nature is in all Animals of the same Species*

The cause of all these *Actions* can be referred to nothing else but *Natural Inclination* and *Instinct*, by which *Animals* are instigated to such and such *motions*, and resolve upon what things are convenient for them: So that this, or that whole *Brutal Species* is carried with one propension, and there is the same force, and the same impulse found in all of that Kind. So every HARE is a like fearful, and by the method of subtilty declines all Dangers and Inconveniences of *Life*. Every HOUND hath a kind of Craft and Innate Industry in following after *Wild Beasts*. All FOXES are shrewdly cunning, and generally use the same sort of *Art* and *Method* in *laying Snares* for *Birds*. Every APE expresses human gestures, and with one and the same sort of imitation receives whatsoever is offered or comes in its way; whence it is evident that nothing of Reason is concern'd in any of these actions, but that *Brutes* are impelled to them by a certain necessity, and according to that familiar saying in *Schools*, they rather *suffer* than *act*. For how can a CAMEL know that a draught of *Water*, the purer it is, the more it causes the *Gripes* of the *Belly* in him; or that in regard of the simplicity of its *Substance*, it affords him the less *nourishment*? How knows a CONY that the *Ferrets* lay ambuscadoes for them, and that if they did not cover their *Hole* to keep them out, they should be expelled themselves by the *injury* of their *Teeth* and *Feet*, and whatever hostility besides? How should a HART know that the Herb *Dittany* is available for the drawing out of a *Dart* shot into his Side? A HEN, that a *Kite* lays wait for her *Chickens* to snatch them away and devour them? Certainly if they did, *Beasts* would be wiser than *Men*, as having the faculty to explore and find out things before they came to make trial, or have experience of them; and being able to understand occurrences, before they could arrive at the *Organs* of their *Senses*. For BEES, we see, scarcely brought forth into the Light, begin to build *Hony-Combs*, gather *Hony*, attend their *King*, and perform all the *Offices* of their little *Commonwealth*. Young ANTS testifie no less *providence* than those of more age. CHICKENS newly hatch'd out of the *Shell*, dread and avoid the *Kite*. The *Kite* by no other Instructor but natural Instinct, lays wait for the *Hen*. The WOLF from his very Cradle, if we may so say, with an innate hostility prosecutes the *Sheep*. The SWALLOW builds and covers its Nest: The SPIDER its *Web*, without any other Teacher but natural Instinct. By which it is plain, that *Animals* are not directed by Reason, but by the Conduct of Nature only, which is alike prevalent in all.

IV. *That Beasts of every Kind cannot but do actions which are proper to them.*

And for the better conceiving that *Beasts* of every Kind ought to perform *Actions* which are proper to them, we need but consider, that they act no otherwise but by the force of their *Mechanism* or *Structure*, and by the disposition of their *Organs*: For as we ought to believe, that they are destin'd to different uses, according to the diversity of their *Species*, so we need not doubt on the other side, but that the Author of *Nature* hath furnish'd every one of them with *Organs* proper for the performance of those *functions* which are most agreeable to their *Nature*; as for example, there are in *Ants*, motions very regular and very necessary to lead them in *Summer* time, to those *Objects* which they have need to make provision of against the *Winter*. *Swallows* build their *Nests* with more artifice than the skilfullest of Men can do: And a *Dog* in finding out his *Master* shews more sagacity than in matters of that nature is usually discerned in Man.

V. *After what manner Bees make their Cells so ingeniously.*

Moreover there occur to us some *Works* of *Nature*, which seem not possible to be performed without *Sense* and *Reason*, as hath been observed in the beginning of this *Discourse*: For how comes it to pass that *Spiders* weave their *Webs* so *Geometrically*, and *Bees* compose their *Cells* so nearly and orderly, each being appointed their several Offices; some to lay up the *Hony*, others to exclude the *Drones*? To which end they make some of their *Cells* oblong, the better to receive the forms of their *Bodies*; and on the other side make them open to leave egress and regress, yet at the same time it is so ordered, that not above two rows of *Cells* can be opposite one to the other, namely, one at the top, and the other at the occluded part. Besides, when in framing the *Walls* of their *Cells*, there is a necessity that the *Wax* be separated, and carried out from all parts: How do the *Bees* so contrive it, that every *Bee* taking its round with compress *Wings*, six other *Cells* should be drawn circularly near the *Wax-Cell* towards the sides, and as many towards the top, and all for the convenience of the circular *Figure*; which is so ordered as to be touch'd by six other equal and conformable *Cells*: Furthermore, there must be a *Hexagonic* or *Sixangled*, and a *Hexaedric* or six-sided Figure, conformable as well at the Sides as at the Top, in such manner, as while six *Circles* are contiguous about a seventh, and make a compression, this compression is to be mutual so far as till it falls into six Sides, equal to a *Semidiameter*, and common as well to the containing as the contained *Circles*.

VI. *The whole operation of Bees proceeds not from Reason, but instinct of Nature.*

But these and the like Operations are not to be attributed properly to *Cognition* or *Cogitation*, but to some other *intelligence*, which *Averroes* calls *Non Errant*: So as that the *Corporeal Nature* must follow the conduct of *Divine Reason*; and its *Works* be look'd upon as *Darts* or *Arrows* which are directed by a skilful *Marksman*, to the Aim or Mark which the *Darts* or *Arrows* themselves have no suspicion or apprehension of. So that this Natural Force infused into every *Animal*, is the Original, and as it were the Source of all those *Motions* and admirable *Effects*, which do not only exceed all our Efforts, but which we can hardly attain to by our greatest application of *Wit* and *Ingenuity*: Whence the Great DES-CARTES in his 45*th Epistle* to a certain Nobleman, *I am not ignorant* (saith he) *that many things are performed by Brutes, far better than by us; but this I do not in the least wonder at, since it helps to prove that they perform them Naturally and as it were by Springs; no otherwise than a Clock or Dial, which declares the Hours far better than we can find it out by our exactest Judgment: And doubtless when the Swallows approach in* Spring *time, they act therein in the*

manner

manner of Clocks or Dials: And whatsoever Bees perform, is of the same nature, as is also the Order which Cranes observe in flying, Apes in fighting; if at least they observe any. Lastly, the instinct by which they are carried to bury their Dead, hath nothing more to be wondred at, than the instinct of Dogs and Cats, who, going about to cover their Excrements, scrape up the Earth in order thereunto, tho' perhaps they never proceed so far as to cover them; which shews that they act unthinking, and only by instinct. But if after all this any one still remains obstinate, and will have it that Intellect and Reason must be allowed in *Beasts* to produce all those wonderful *Operations*; what hinders but that whatsoever things in Nature give occasion of admiration, may be said to proceed from Reason? Why may we not by the same reason maintain, that a *Clock* or *Dial* is indued with *Intellect*, as long as the *Index*, turning about by a *Spring* of *Motion* infixt, sometimes by a deflux of *Water*, sometimes by the stress of a *Weight* hung on, sometimes turned about by the reflex of an intorted *Steel*, designs the Hours? Why may not the *Needle* be said to be prompted by Reason to fly to the adjacent *Loadstone*, for the obtaining of its imbraces? The *Bees* therefore erect their Habitations, as HARVEY admirably expresseth it, by a Natural impulse, and as it were by a fatal necessity, or a certain mandate, working according to the Law of the *Creator*, but act nothing by *Providence*, *Design* or *Councel*. For what in us is the *Principle* of *Artifical Operations*, and is called *Art*, *Intellect* or *Providence*; that in these *Natural Works* is meer Nature, depending upon no *Mans Instruction*.

VII. *Whence ariseth the diversity of Actions in Brutes.*

But if it be required, how it comes to pass that so great a diversity of *actions* should be produc'd among *Beasts*? How each *Animal* should have its proper *Machination*, if they operate according to inbred *impressions*, and are impelled as it were by a certain *weight*? I answer, that this happens from the various disposition of the *Brain*, and the *Organ*, which according as it varies in *Animals* of a different *Species*, so it brings to pass, that an affection of the same *Object* is directed to different *Motions*: Forasmuch as nothing else can be understood by the name of *Natural Instinct*, than the *Local Motion* as of the whole, so of the minute parts indued with a certain *magnitude* and *Figure*, according to which *natural things* are distinguish'd, and obtain various denominations. Now those *motions* which follow *corporeal dispositions*, may be reduc'd to three Heads. The First is of those, by which *Animals*, through a certain inbred impulse, hate and decline those things which are hurtful and troublesome to them; as a *Sheep* abhors the sight of the *Wolf*, and immediately upon the said sight thereof, betakes it self to flight with all imaginable haste: Almost all sorts of *Animals* dread the *Lion*, and are terrified at the sight of him: On the other side, the *Lion* fears the *Cock*, and trembles both at the hearing of his *Crowing*, and sight of his *Crest*: So the *Chickens* fear and fly the *Kite*, &c. The Second is of those by which *Beasts* apply themselves to the propagation of their Kind, and the generating of their like; so the *Silkworm* weaves its *Egg*; so *Fishes* and other *Animals*, by a certain inbred propensity, do many things which tend to the foresaid end. The Third is of those things by which *Brutes* provide for their own preservation, and sustain themselves from perishing, they go out to get their *Food*, they make choice of their *Meats*, they lay up *Provision* against the approaching *Winter*, and do several other such like *actions* which conduce to the said end.

VIII. *Whence ariseth the Hatred and or Antipathy between some Animals.*

The *Motions* of the first Kind are easily made out, when we affirm that by the sight of such Objects, certain impressions are transmitted through the *Fibres* of the *Nerves* into the *Brain*, which convey the *Animal Spirits* into the *Nerves*; which upon turning the *Back*, or moving the *Thighs*, are readily disposed to help on the *flight*; and also partly upon those *Nerves* which dilate or contract the *Orifices* of the *Heart*, or which agitate other parts from whence the *Blood* is sent into it: That this *Blood* being rarified, after another manner than is usual, sends into the *Brain* those *Spirits* which are adapted to the cherishing and fomenting of Terror, that is, which are apt to keep open, as also to open again those passages of the *Brain* which conduct them into the said *Nerves*: So the Sight of the *Eye*, from the *Body* of a *Wolf*, reflected upon the *Eyes* of a *Sheep*, hath the force of disposing the *Spirits*, and diffusing them into the *Nerves* in such a manner as is necessary for promoting the flight of the *Sheep*: The like may be said of *Chickens* flying the *Kite*; the *Lion* the *Cock*, and other *Beasts* the *Lion*. For it is the nature of the *Brain*, and of the contexture of the *Fibres*, into which an impression is made in the said *Beasts*, to produce such an affection. And that such a Disposition and Temperament is found is *Beasts* is sufficiently manifested by the steam exhaling from the body of a *Camel*, by which a *Horse* is so terrified, that he becomes incapable of standing a fight: Of such a Nature likewise is the smell of a *Horse*, that thereby an *Elephant* is driven into madness: The Root also of the Herb *Valerian* sends forth a *Vapour*, which works so upon *Cats*, that they are thereby driven into a merry Pin, and skip and frisk about like mad. In regard that such or such an affection is not grateful or ungrateful of it self, but upon this account, that there is such or such a conformation of the *Organs*, and contexture of the *Fibres*, which is found in these *Animals*. Nor is it haply for any other cause that the *Cock* awakes before light, and by his Crowing proclaims the approach of *Day*, than because the *Sun* having passed the Circle of *Midnight*, and having almost overtaken the *Morning*, puts to flight the cold *Air* of the *Night* by his approach; by which coldness the *Cock* being raised and awakned, is so stirred up and alarm'd, that he presently sets up his Note, and by his loud Crowing calls up mortal Men to their tasks and labours.

IX. *Whence proceeds the Love of Beasts one towards the other.*

By the same reason may the Love of *Beasts* be set forth, for example, when an Object is agreeable, the Light which is reflected towards the *Eyes* of the *Animal*, strikes the *Optick Nerves* in such sort, that they dispose the *Animal Spirits* to insinuate, part into the *Muscles*, which have their course toward the *Tail*, *Head*, *Legs*, &c. part into those which serve to inlarge the *Orifices* of the *Heart*, and to press the parts of the *Heart*, whence the *Chyle* and the *Blood* may come in greater abundance; which not only causes the *Animal Spirits* to

to mount up to the *Brain* in the greater quantity, but also gives them a freer course into the same *Muscles*, and by this means to conserve, entertain and fortifie those *motions* which the presence of an agreeable Object hath caused.

X. *Whence their Passions.* So that the *Passions* of *Animals*, taken not for *Simple Faculties* but for *Actions*, are nothing else but the *emotions* of the *Brain*, caused by the presence of whatsoever Object, whether hurtful or favourable, and fortified by some particular courses of the *Animal Spirits*, which depend principally upon the disposition, which the Heart and others of the Principal Bowels put into the *Blood*.

XI. *The Composition of the Machin of a Beast more exact than any other.* You will, possibly, have much ado to conceive that *Beasts* should do all that we see them do, after the manner of things Inanimate; as for Example, of a *Clock* which marks the Hours, and strikes by virtue of the disposition of its Wheels, and the force of its Counterweights: For tho' in *Beasts* we take notice only of their *motions*, yet the great number of those *motions* is very surprising, and it is a hard matter for any one to persuade himself that so many can be included in a *Machin*. But I will easily deliver you out of this pain, if you have the representation before you of a *Clock*, for Example, composed but of 15 or 20 pieces, which nevertheless strikes all the Hours, marks the Half hours, the quarters, and all other parts of Time which are numberless. Now if a *Machin*, which is composed of so small a number of Pieces, is capable of so many things, how many must we imagin the *Machin* of a *Beast* capable of, which is compos'd of *Spring-Fibres*, whose number and due disposure surpasses, without compare, the structure of the exactest *Machin* that ever was made by any *Workman*.

XII. *The Machins of Beasts are wound up as other Machins.* If it be answered, that there is a great difference between a *Beast* and an Artificial *Machin*, in that a *Clock* may be wound up every day; but that the *Machin*, for example, of a *Dog*, cannot be so wound up. It is evident, that all *Machins* are not wound up, or renewed after one and the same manner. *Pocket Clocks* or *Watches* have their Springs; certain *Turn-broches* or *Jacks* have the smoke of the Chimney to make them move; *Mills* have Water or Wind; *Thermometers* have heat or coldness of the Air; the *Hydrometer* divers degrees of Moisture: So likewise *Beasts* have their Aliment. So that we may well say, that their *Machins* are wound up as often as they have any thing given them to eat or drink.

XIII. *A Dog is not carried by Cognition to snatch at a piece of Bread.* But if there be no difference between *Beasts* and other *Machins*, whence comes it that a *Dog* can snatch at one bit of Bread or Meat, and reject or refuse another bit which is offered him, if he have not a *Cognition* or discerning *Sense* to accept the one and reject the other? Who can think it necessary, that there should be *Cognition* in a piece of *Iron*, to cause it to move towards the *Adamant* or *Loadstone*, and not as well to move towards a *Flint* when it is offered to it? Or who will think himself obliged to admit of *Cognition* in a *Dog*, to cause him to run away at the sight of a *Cudgel*, when it is offered to him, any more than in a piece of *Iron* shunning when the *opposite Pole* is presented, that very *Adamant* by which formerly it had been attracted.

XIV. *A Dog feels more pain, because he crys when he is beaten.* And certainly these who believe that a *Dog* feels pain, because he crys when he is beaten, have as little reason for their belief; since the greatest sound that can be heard when the *Organs* are touch'd in certain places, is not a sign that there is any pain in those *Organs*: So that there cannot be proposed any such action of *Beasts*, but I can produce something like it, which you must necessarily confess does happen in other subjects, which can no way be imagined capable of *Cognition*; and you need do no more but see with your *Eye*, and touch with your *Hand* the several *Organs* of *Beasts*, and their different Structures, to make you comprehend how the greatest part of their Actions may be performed without *Cognition*, after which you will find no great difficulty to acknowledge, that the same may be said of all the rest.

XV. *A Swallow shews nothing of Cognition in building her Nest.* No more doubt need to be made, that a *Swallow* may without knowledge, imploy it self in building a Nest of Mud, with the greatest Artifice imaginable; may gather up heaps of Straw and Chaff to make a curious sort of Straw-work, may search about for Feathers to lay a top, for the making of her Bed the more soft and warm, the disposing of her *Eggs*, and the covering and cherishing of her Young Ones after they are hatcht, till such time as they are in a condition to fly, and shift for themselves, and seek their own Food; since there are many things that have not the least *Cognition*, which exactly perform that which Men cannot do with all their Ingenuity. I might here recount a world of Examples, but I shall only add, that a *Stone* hung at the end of a *Pole*, marks out the direct way to be kept for to go to the Center of the *Earth*, that the Needle of the Compass points out the *North*, that a Fane shews the Course of the Wind, that a Clock or Dial marks out the Hours more exactly than the Learnedest Man of the World can do. Moreover, there is not a Goldsmith, the cunningest of them living, who having the filing of Iron mingled with that of Gold or Silver, can in the dark separate the one from the other, and even by plain day-light it would cost him much time and labour to effect it; whereas a Loadstone performs the same in a moment, without the help of Day or any other Light. By this we may see that the exactness with which many *Beasts* perform certain operations, is not an undoubted sign that they perform them with *Cognition*: And besides, with what exactness or curiosity soever some *Beasts* may act, they have never produc'd any thing that can come near that rare skill wherewith the least Flower of the Field pushes forth its Bud, its Blossoms and its Leaves.

XVI. *Nor a Bee in the contrivance of its Comb.* Nor did ever any *Bee* make Compartments in his Comb more exact and curious than those of a Pomegranate. And if it be so marvelous a thing to see a *Dog* seemingly sensible, when his *Machin* is wholly disposed to move after a *piece of Bread*, or in pursuit of a *Hare*: So that tho' we perhaps may think our selves obliged to admit of *Cognition* in him, yet it is true, that his whole *Machin*, which is infinitely more strange in its Fabrick, than it is strange to see it go when it is made, hath nevertheless been so composed, as to be without *Art* or *Cognition*, and to act by motion only, and the disposition of its parts: Moreover the Argument drawn from the exactness with which *Beasts* perform many different Actions, proves too much:

For

For we ſhould thence be forced to conclude, that *Beaſts* have more perfect *Cognitions* than *Men*, as we have ſaid before, and that the principle of theſe *Cognitions* is more noble than theirs, which certainly no rational perſon will eaſily grant.

XVII. *How Brutes are impelled to Generation.*

But let us repeat our Diſcourſe, interrupted by this long digreſſion, concerning the operations of inanimate things, compared with the actions of Animals, and explain the Motions of the *Second Kind*, with the ſame eaſe as we have thoſe of the *Firſt*. For that *Beaſts* are incited to Generation and Propagation, proceeds from the alteration made in their *Bodies*, by which their *Fibres*, and the Contextures of them are ſo diſpoſed, that from thence a certain affection is derived, (eſpecially in thoſe *Organs* that are inſervient to Generation) which is directed to the foreſaid Motions. For *Luſt* is a certain diſpoſition of the *Animal Phantaſie*, proceeding from the *motion* of the *Genital Parts*; that is, while thoſe parts are tickled by the fervid Spirits, and impelled to Coition. So when a Proud Bitch is brought to, or comes in company of a Dog, ſhe by her ſmell ſo diſpoſes the unquiet Spirits in the Head of the Dog, that they make a conflux into the parts adapted for Generation to perfect the Coition. Whence that *Tentigo*, which in many Males accompanies Luſt, is wont to be made by the Animal Spirits, whilſt they flow down to the Fungous Nerves of the Maſculine Member, and are hindred from returning by the *Proſtates*, ſwelling with the Fervid Seed, and ſtopping up the Pores of thoſe Fungous Nerves; ſo that Animals, when they are libidinouſly inclin'd, are of that diſpoſition, as eaſily to be directed to thoſe Motions which tend to Propagation, and the preſerving of their Kind, as ſhall hereafter be more largely diſcourſt of concerning *Birds*.

XVIII. *What Imagination is in Animals.*

When, I ſay, that Luſt is a certain diſpoſition of the Animal Phantaſie, I would not have it ſo underſtood, as if it were ſome internal Principle, from whence a certain Imagination ſhould proceed, but only that it is a ſimple motion, proceeding from the courſe which the Animal Spirits take of themſelves acroſs the *Fibres* of the *Brain*; whence it follows, that the Imagination of Animals, taken for a ſimple Faculty, is no other than a power which the Animal Spirits have to flow, as of themſelves, from the Brain into ſome certain Muſcles, rather than others, for the moving of ſome particular Members.

XIX. *How it comes that Brutes are concerned for themſelves, and the preſervation of their lives.*

With the ſame clearneſs may the Motions of the *Third Kind* be made out: For Nature hath been beneficial to all Creatures, in furniſhing each of them with their proper Organs, and impreſſing that habit of Body, by the help of which, and of the ſaid Organs, they are enabled to ſtir up thoſe Motions, by which they may the better provide for their Life, and proſecute thoſe things which are neceſſary for the preſervation of themſelves. It is infuſed by Nature into all ſorts of Animals, as ſaith the Latin Orator, to defend themſelves, and take care of their Life and Body, and to decline thoſe things which ſeem hurtful to them, and to ſearch after, and endeavour to obtain all things that are neceſſary for the preſervation of Life. Wherefore it is no wonder, if *Brutes*, with ſo much application, are intent upon their preſervation, by building themſelves places of abode; by ſeeking their Food, even rather than fail, by force and rapin; by providing and laying up ſuſtenance, by diſcerning and diſtinguiſhing ſome Meats from others, and doing ſuch like actions as tend to ſuſtain and keep themſelves from periſhing: Forasmuch as *Beaſts* are ſo framed by Nature, that by their Meats, by their Retiring Places, *&c.* they are diſpoſed to thoſe Motions, from which they uſe to be prompted to Feed, and to betake themſelves to their Receptacles: Whence it comes to paſs, that they diſtinguiſh the Meat agreeable to them, from that which is not; and that they decline ſome things, and accept of others: For Example, for the curing of Diſeaſes, and reſtoring to Health from any Diſtemper; the *Ring-Dove* and *Blackbird* make uſe of *Laurel*. For purging the Belly, the *Dog* hath recourſe to *Graſs*; the *Hen*, to the *Wall-flower*; the *Swallow* uſeth *Celandine* for clearing the *Sight*; the *Tortois*, *Origanie* againſt all ſorts of *Poiſon*: To which choice doubtleſs, they are only prompted by the very inſpection of the Herb, becauſe of the different temper of the Body, and the various contexture of the Fibres. Forasmuch as from Trees and Herbs ſuch *Emanations* ariſe, as are proportionate to the *Senſorium* ſo affected, and not like thoſe which flow from other ſorts of *Plants*; and therefore, as *Animals*, when they are preſt with Hunger, are not promiſcuouſly allured by all ſorts of Meat alike: So when they labour under any Diſtemper, they are not by the ſame impulſe carried all to one and the ſame Herbs, but to thoſe only, by which they are diſpoſed, and in a ſort attracted by the peculiar odour which affects them. Nor can any other reaſon be aſſigned, why the *Stork* makes uſe of his Bill and long Neck inſtead of a *Clyſter-Pipe* to purge its ſelf of all Noxious Humours; or why the *Serpent* rubs himſelf upon *Fennel* to heal his diſeaſed *Eyes*, except becauſe the ill affection of the Belly and Eyes, prompts, allures and impels to theſe motions; whence it plainly appears, how prodigal of Reaſon they are, who allow it to *Brute Animals*, and have recourſe to I know not what *Soul*, which muſt forſooth lie latent in them, and be attributed as a principle to all their works, when as at the ſame time, there is no mutation to be diſcerned in them; things are always performed after one and the ſame manner; variety of place, time and age, produces no diverſity in their Operations, which happens not ſo in Man, as being participant of Reaſon: There being innumerable ways and modes of Human Actions: And there is not in every Man one only action, or one propenſity as in *Beaſts*, but in each Man a ſeveral Inclination, ſome proper to one, ſome to another, according to the condition of the Soul; whence it comes to paſs, that there is ſo great a diverſity of Opinions in the minds of Men, ſo that few Men think one and the ſame thing, hate one and the ſame thing, affect one and the ſame thing. Of the firſt Claſs of the Actions of Animals, enough hath been ſaid already; let us now haſten to examin the others, in which there are apprehended ſome appearances, not only of Perception, but alſo of Judgment and Ratiocination, ſuch as are *Dubitation*, *Invention*, *Determination*, &c.

XX. *How it is that Animals doubt.*

It can ſcarce be denied, or indeed ſo much as queſtioned, but that Animals may ſometimes ſeem to doubt, demur, or be, as they ſay, at a *Non-plus*. We find that a *Horſe*, when two bundles of

Hay, or two meaſures of *Corn* are ſet before him, makes choice of one and rejects the other; and it is not unpleaſant, ſometimes to behold a *Cat*, when Meat a little too hot is thrown to her, at a ſtand whether ſhe ſhould refuſe it, or fall to: For firſt touching it with a light Foot, then nicely putting her Mouth to it, ſhe heſitates a while, with her Ears ſhrunk up, as it were meditating in her mind which of the two ſhe ſhould preſer, feaſting or abſtinence, till at length declining the latter, ſhe makes choice of the firſt,and ſticks to that reſolution.

Theſe and the like actions, which ſeem to argue in *Brutes* a liberty and indifference, are to be attributed only to different motions which are in the *Brain*: For different Objects produce different Motions in the Organs of the external Senſes, which by the help of the Nerves being carried into the Brain, excite ſome other motions, by which the Spirits being directed variouſly, impel the *Conarion*, and ſo bring it into an *æquilibrium*, ſo as not to incline more to one part than another: Whence it comes to paſs, that *Brute Animals* remain indifferent, and ſeem unreſolved whether to take, or leave their Meat: For ſince theſe Spirits are Corporeal, they excite oppoſite motions in the *Glandule*, which thwarting one another keep the ſaid *Glandule* unmoved, and ſuffer it not to decline to one part more than another; and this happens not only to *Brutes*, but ſometimes alſo to *Men*, that is, to thoſe, who, being deprived of their Senſes, act without Counſel or Deſign. MEDINA makes mention of a certain Madman, who having two Apples offered him at the ſame time, could not reſolve which to fix upon, and ſo in much perplexity remained a good while in ſuſpence without taſting of either, till at length a certain Friend of his took theApples,and preſenting him with one, reſerved the other till that was eaten; whence it evidently appears how different the heſitation of *Brutes* is from the ſuſpenſion of Judgment. For when by Perception we diſcover any thing which was hid from us before, and of which we had not yet made any judgment, Our *Mind* by the help of the *Will*, that is, of that faculty which it hath of moving it ſelf, and determining, remains doubtful, and ſuſpends the Judgment; if it apprehends any obſcurity in the thing, afterwards deliberates; and as ſoon as it finds the matter cleared, gives its aſſent, which it denies to other things which do not appear ſo clear and evident. But in regard *Beaſts* want *Will*, and are only prompted by Corporeal Objects; no wonder they do not in reality either doubt or make choice of any thing with judgment, becauſe not reflexion, but only a recourſe of certain Images, cauſes the ſaid dubitation.

XXI. *The Craft and Subtilty of ſome Creatures.*

The Craft which moſt Animals make ſhew of,and the Wiles which they uſe in their Actions, are not thought to be made out with the like facility; foraſmuch as ſo great a ſemblance of Reaſon appears in them, that ſome may poſſibly be induc'd to think, that the ſaid Animals are led by Cognition, and act by an inſpection of ſome end or deſign. But becauſe the *Fox* excels all other Beaſts in cunning and ſtratagems, and is therefore propos'd by ſome Writers as an example of ſubtilty, it will not be amiſs to relate ſome of the Tricks and Machinations of this ſubtil Creature, in regard they being laid open, it will the better appear after what manner the operations of other Animals are brought about. PLINY makes relation that the *Foxes* in *Thrace* do nothing inconſiderately, inſomuch that being to paſs frozen Rivers, they do not preſently commit themſelves to the hazardous paſſage of them; but firſt going ſoftly, and with a light Foot, they apply their Ear and liſten the better to make trial of the thickneſs of the Ice: For when they hear any thing of the murmur of the underflowing Water, they ſtop their courſe, and unleſs any danger attend them behind, ſtir not a foot farther; but in caſe no noiſe be heard, nor any fear of danger be diſcovered, they purſue their courſe and get clear over. For they ſeem to reaſon with themſelves after this manner: That which *makes a noiſe* is moved, that which is moved is not firm, that which is not firm muſt needs be fluid or *liquid*, that which is *liquid* cannot be retained or kept back, but may give way; therefore this River is not to be paſſed. Another ſubtilty is related of this Creature by the ſame Author, in catching and getting poſſeſſion of its Prey: When-ever he beholds a flight of Birds in the Air, rowling himſelf in Red Sand, that he may appear all bloody, holding his Breath and lolling out his Tongue, counterfeits himſelf dead; by which means when the Birds come to ſettle upon his Body, he on a ſuddain ſnaps them, and devours them. Likewiſe when he is hunted, and the Dogs drive ſo cloſe upon him, that he is in danger of being taken, he makes uſe of this ſtratagem: Having ſtail'd he beſprinkles his Tail with the Urin, then ſhaking it all about, he indeavours to avert the Dogs by the ſtink thereof, thereby to free himſelf from the harm that attends him. The like trick he makes uſe of to drive the Badgers from their Kennels; as ſoon as he perceives them gone out, he enters in, and leaves ſuch a ſtink with the Excrements he voids there, that they are forc'd to make their Lodgings elſewhere. No leſs Fox-craft is ſhewn in freeing themſelves from the Fleas with which they are oft-times moleſted: For taking a wiſp of Straw, or any ſort of ſoft Stubble, they plunge the hinder part of the Body in cold water, from which the Fleas flying, get up to their Heads, which then they plunge in like manner in the water, upon which the Fleas make their eſcape into the Straw or Stubble; and by this means the Foxes get away and leave their Gueſts behind them. A greater ſtratagem than all theſe the famous Sir KENELM DIGBY relates of a Fox, who being hard preſſed by the Dogs, entred into a *Warren*, and there hung upon a Rafter among the Carcaſes of the ſlain Animals, until ſuch time as the Dogs having loſt the ſcent, were paſſed by the place. Alſo of another, who urged by the like neceſſity, caught hold of a Broom Shrub which ſhot up over the Mouth of his Kennel, which was plac'd in the broken clift of a Rock, and to which there was an eaſier acceſs by another way,and ſo by an accuſtomed and well-known paſſage, ſlipt ſafe into the Hole, whilſt the Dogs eager in purſuit, and not ſuſpecting the danger of the paſſage, fell down among the Rocks to their deſtruction.

XXII. *Paſſion always follows Appetite, and the alteration of Animal Spirits is made in the Body.*

Now that the Cauſe of theſe Operations may be the better demonſtrated, two things are to be ſuppoſed out of what hath been already ſaid; Firſt, That always ſome affection accompanies the ſenſitive

ſitive Appetite. For it cannot be otherwiſe to make every Animal have an Appetite or Averſation, but that ſome perturbation muſt ſpring up in his Body, which taking its ſource from the Blood and Spirits, dilates or contracts the Veſſels or Ventricles of the Heart, and at the ſame time agitates other parts of the Body; by which it comes to paſs, that according to the various reception of Spirits, ſome paſſages of the Nerves are incited to an opening or ſhutting, and thereupon the Animal is rendred prone to follow after or decline: Hence Brutes if they are preſt with Hunger, are unquiet, and by the Nerve of the Sixth Conjugation, inordinately agitated in the Ventricle are impelled to the motions of the Members adapted to the purſuit of Aliment. Secondly, When as all the motion of the Body of an Animal is ſtirred up by the contacts of exteriour Objects, it comes to paſs that in the Ventricles of the Brain certain Pores are opened by the tranſcourſe of Animal Spirits, which retain a greater facility of opening themſelves, than thoſe through which the Spirits have not yet pierc'd: Whence it comes to paſs, that if any Object occur, like to that at whoſe preſence thoſe diſtinct draughts are delineated, the Animal Spirits ſtirred up into motion, fall into the Veſtigia formerly made, and after the ſame manner as before, move the Members of the Body. As if a *Bull*, for examples ſake, be ſeveral times removed from a fertile into a barren and unfruitful Soil; the Stomach being ſtirred up with Hunger, and pricking the Membrans with an acrimonious Humour, the paſſages of the Ventricle are twitcht by the Spirits, which being carried to the Brain, and making their Courſe through paths already formed, repreſent to the Bull the more delicious Meat formerly fed on, and thoſe more fertile Fields where heretofore he uſed to feed, and which entring the ſources of the Nerves, paſs into the Muſcles deſigned for the moving of the Legs, and as it were compel them to make after their former Paſtures: For tho' their Memory be not indued with any great activity, and that facility, and thoſe draughts which are impreſt in the Brain, and which the Spirits leave in the Fibres through which they are carried, may ſeem to perform little; yet they produce all thoſe wonderful effects which are obſerved to be in Brute Animals, and induce the greateſt part of Mankind to believe that they make uſe of Cognition, and are govern'd and prompted by ſome Spiritual latent Principle. Nay, if the matter were throughly ſearcht into and examined, *Memory* is the effective cauſe of moſt of the Actions which we negligently and without attention perform, as I have formerly hinted concerning the *Minſtrels*.

XXIII. *How the Foxes in* Thrace *being to paſs a River, lay their Ear to the Ice.*

Theſe things thus premiſed, let us return to our Foxes: As for thoſe in *Thrace*, which refuſe to commit themſelves to the congealed Rivers till they have firſt made proof of the ſolidity of the Ice; it is certain that they do not do this by Judgment, but by the benefit of Memory; ſince it might poſſibly happen, that the noiſe of the Water being heard from another place under the ſame covering, they might notwithſtanding their politick liſtning, fall in and ſuffer no ſmall prejudice in thoſe Bodies of theirs they take all this care of: Or that in the *Winter* time when they have diſcovered the courſe of the Waters, they have been ſeiſed with cold, the Memory whereof ſmiting their Phantaſie, deters them from ſwimming at that time: But as to their moving their *Ear* to the Ice to explore the thickneſs thereof, that proceeds from fear, by which the Spirits being excited, betake themſelves to thoſe Muſcles which are inſervient to the bending of the Head, and terminate at the Ear which is to be applied to the Ice: Whence it is apparent, that the Fox in this caſe makes no uſe of Ratiocination, but is impelled by Affection; is not indued by Cognition, but actuated by Paſſion alone to ſuch like Motions.

XXIV. *How the Fox to get Birds, counterfeits himſelf another Creature.*

But as to their lying as dead in ambuſh to catch by ſurpriſe the unwary Birds; as to their lifting up and ſetting their hinder Feet againſt the ſtem of a Tree with their Head downward and their Fore-Feet on the ground, and ſmiting often with their Tail againſt the Tree, thereby to ſtrike a terror into the Hens, and cheat with a ſhew of ſome other Animal leaning againſt the Tree: As to the ſhooting the light of their ſparkling Eyes upon the Hens, while their whole Bodies beſides lie hid in the umbrage of the Night; that being inticed by the ſaid light, they may forſake their Perches where they rooſt, and lighting on the ground, fall into their Clutches: All this is to be attributed not ſo much to their Craft as to Chance. For it might probably happen, that a Fox wearied with a long march, might lie down upon the ground and fall aſleep, to whom, lying as it were dead, the Hens might very well approach without fear; which the awaking Fox perceiving, ſtill counterfeits himſelf aſleep, the better to take his opportunity of falling upon them unawares. The like luck hapned to a Fox mentioned by PETRARCH, which Fox when the Fiſhermen that carry Fiſh to the City, as commonly they do in a *Summers* Night, found lying for dead acroſs the way, they took him up, intending to flea him for his Skin, and threw him into the Pannier of Fiſh, whereof when he had plentifully feaſted, out leapt the Fox, and to the great aſtoniſhment and vexation of the Fiſhermen, got clear away with his Belly full of Fiſh. By the like fortune it might be, that when a *Fox* ſaw *Hens* rooſting on a Tree, and not being able to reach them, ran round about the Tree, as ſeeking ſome place of advantage whereby to raiſe himſelf to a higher ſtation, mean while the Prey fell into his *Mouth*, and he injoyed his wiſh without any further trouble. Whence it is probable, theſe tricks ſo happily ſucceeding, that afterwards upon the barking of an empty *Stomach*, and the inſtigation of *Hunger*, the *Spirits* repeat thoſe paſſages of the *Brain* which they entred, when lying as aſleep or *dead* upon the *ground*, he thereby got his Prey. Which Artifice, often repeated, becomes a cuſtom, and fixes deep into his *Memory*, ſo that when ever after he *hunts* for *Food* and lights upon any *Prey*, he repeats the ſame ſeries of *actions*, and makes uſe of the ſame *ſtratagem*, as hath formerly proved ſo proſperous and ſucceſsful to him. The truth of it is, many actions which appear not a little ſtrange in *Beaſts*, at firſt were performed by them, by ſome certain caſualty, which *actions* having afterwards been made familiar by frequent experience, paſſed into *habits*, which ſeemed to carry in them a great deal of *Wit* and *Sagacity*; and ſuch in all probability was the chance of a certain *Wood-Fox* (mentioned by the

the famous Dr. WILLIS) who to get into his Clutches a *Turky*, pearching upon the Bough of a *Tree*, made use of this device to catch it: He circuits about the *Tree* with a very swift and eager pace, keeping an intent *Eye* all the while upon the *Bird*, and by this means obliged him to return the like intention of aspect, which to do, he was forc'd to turn about his *Head* so often, till at length becoming giddy, and taken with a *Vertigo*, he falls from his Pearch into the very Jaws of his *Enemy*.

XXV. *How the Foxes deceive the Hens by directing their Eyes towards them.*

By the same reason it is that *Foxes*, by casting fixedly their *Eyes* upon the *Hens*, either seduce them, or attract them; forasmuch as it was likely enough to come to pass by chance, that while the *Foxes* were prest with *hunger*, and stood gaping after their *prey* that sate aloft, they might so long direct their *Eyes* upon the *Hens*, that they either astonish'd at the *Foxes* sparkling *Eyes*, or struck with suddain fear, might slip down, and fall into the Jaws of the *Insidiatours*, by reason that the *Hens*, either affrighted by the continual sparkling brightness of the *Foxes Eyes*, or thinking themselves already taken by the *Enemy*, are seised with such a sudden astonishment and confusion, that they cease and let fall all their natural *Functions*; as if their *Bodies* had no offices to perform: By which means it happens that they first begin to totter, and immediately thereupon by the solution of the *Nerves* in their *Legs*, drop half dead upon the ground. The same thing is also observed in other *Birds*, who when the *Cats* get upon the *Boughs* of the *Trees*, and thence fix their *Eyes* upon them, as if a suddain *Vertigo* seised them, they drop down from their *Pearches* upon the ground.

XXVI. *How the Fox pursued by the Dogs, comes to dip his Tail in Urin.*

As to the Craft of *Foxes*, when they are in danger, watering their *Tail* in their own *Urin*, and sprinkling the *Dogs Eyes*, this I take to proceed not from the *Foxes* cunning, but the fear that seiseth him. For it is a common thing among all *Creatures* upon the apprehension of an approaching danger, to let their *Urin* pass from them, as it were unawares; in regard the *Spirits* being then disturbed, are hindred from their wonted *Functions*, and the *Nerves* in the *Bowels* being relaxed, there follows a *profluvium* of the *Excrements*; and whereas upon the said fear they contract their *Tails*, and draw them in between their hind *Legs*, they must needs be soak'd in *Urin*, which upon the shaking of their *Tails* is sprinkled into the *Dogs Eyes*, and almost blinding them, hinders their pursuit.

XXVII. *How it is that Foxes free themselves from Fleas.*

Nor doth that Craft of the *Fox* to free himself when he is bitten by *Fleas*, depend upon a higher cause: For in the *Summer* time, when *itching* accompanied with *heat* is stirred up in his *Body*, to remove the same, he enters into a *River*, where first having found some refrigeration in his *Feet*, he ventures to enter deeper, and by degrees immergeth all the other parts of the *Body*; but to avoid the necessity of plunging in too deep, and the trouble of swimming, which would probably heat him afresh, he carries along with him in his *Mouth* into the *River boughs* of *Trees*, or *wisps* of *Hay* or *Stubble*, to which the *Fleas* flying for refuge to avoid drowning, and sticking thereupon, leave their Landlord clear of them. In the mean time the *Fox* finding his *Limbs* finely cool'd and refresh'd, returns into the *Wood* from his importunate Train, and delivered from the vexatious *itching* that had so lately molested him. Whereupon afterwards mindful of the pleasure and profit he thus received in the *waters*, whenever the like occasion happens, he resolves upon the same method, betakes himself to the same actions, till at length the trick becomes familiar, and by frequent reiteration turns into a habit, because after the *Vestigia* of the *Memory* have brought back upon the *Glandule* the first Image of the thing, the *Spirits* returning by the same passages flow into the same *Muscles*, and so dispose the *Foxes* Body to produce the same *actions* he had produc'd by occasion of the Object that first excited: So that all *Arts* which *Animals* put forth on several occasions, depend upon the observation that comes into their Memory, of what before succeeded or not succeeded, as may be demonstrated in *Thales* his *Ass*, who when laden with *Salt*, had a *River* to pass, and by chance plunging somewhat deep in, melted the *Salt*, found himself eas'd of his burthen thereby, by which success being incouraged, he as often as he entred the said *River*, went in on purpose the farther, and rolled himself with his burthen in the *waters*, nor could he be reclaimed from this manner of acting, till in the place of the *Salt*, a Sack of *Wool* was put on his *Back*, which being made more ponderous by sucking in the *waters*, eluded his *Asinine subtilty*, and caused the Master from thenceforth to take new measures, and abolish a custom so incommodious to him.

XXVIII. *What is the cause that Beasts remember.*

For when *Sense* or *Imagination* hath disposed the *Animal Spirits* to begin their course, the tracts thereof which are formed in the *Brain*, are so much the more deeply impress't, as the *Action* of the *Animal Spirits* hath been the stronger, or hath lasted a longer time, or hath been the oftner reiterated; for such strength, duration and reiteration are the causes that these tracts are not easily to be effac'd, and that they are in such sort conserved, that they may be raised there again, a long time after. And thus you have in a few words what it is that occasions the *Memory* of *Beasts*, tho' they are not capable by Discourse or Speech to express it.

XXIX. *How it is that the Fox drives the Badger out of his own Hole.*

As to the trick made use of by the *Fox* to drive the *Badger* out of his Hole, that is to say, by staling or voiding his *Excrement*; I find not in the performance thereof, that there can be any necessity of having recourse either to Judgment or Providence, since there is nothing in it but what may be very well effected by instinct of *Nature*: For what is more natural to *Beasts*, than to defile with their *Urin* or *Dung* any place where they have continued never so small a time, if necessity at that time urgeth; so that it need not in the least be questioned, but that a *Fox* entring a *Badgers Den* when he is absent, may very well leave a notable stink behind him, and that through the abhorrence thereof the *Badger* may be driven to seek out for another place to *Kennel* in.

XXX. *Whether it be an evidence of Reason, that the Fox when he is hard pursued by the Dogs should hang himself up by the Teeth among dead Carcases.*

I must confess it is not so easie to make out, how a *Fox* should without Knowledge, so industriously defend himself from the *Hounds* following him with a great *Cry*, by intermingling himself (if what is related of him be true) among the *Carcases*, which by chance were hung up in the

the *Warren*, unleſs with the Illuſtrious DIGBY, we grant it might ſo happen, that the *Fox* through fear or laſſitude, ſeeking out for a skulking hole, and not finding in that plain tract of *Earth* (ſuch as a *Cony Borough* or *Hare Warren* uſeth to be) any *Buſh*, *Bramble* or *Hillock*, or any other place to betake himſelf to, except that *Animals Gallows* (as we may call it) where ſuch ſort of *Beaſts* were hung up, might be induc'd, his Phantaſie ſo ſuggeſting, eſpecially when he was driven to the utmoſt of his Courſe, to intermingle himſelf among the ſaid *Carcaſes*, which ſeemed to him in a ſtate of deep repoſe; and ſince it could be no other way effected but by hanging himſelf up by the *Teeth*, he put himſelf in that poſture, and ſo continued till ſuch time as the *Dogs* running under the place, overſhot their *Prey*, which they little ſuſpected to be hanging in the *Air*, and ſo loſt the ſcent, which while they endeavoured to recover, he by haſtning into the next *Woods* and *Coverts*, and getting away by ſtealth, took another Path, and thereby clearly evaded the danger and ſtreights he had been reduc'd to.

XXXI. *How it is that the Fox cloſe followed by the Dogs, had the luck to catch hold on a Broom Bough which hung over a Precipice.*

As to that *Fox*, who from a *Broom Bough* which he laid hold on, threw himſelf into his skulking Hole (the ordinary place of refuge whenever near it) being ſo hard preſt behind by the *Dogs*, that he could not go the readier way where there was an eaſier paſſage in; on the one ſide, the ingreſs taking up his whole Phantaſie, on the other ſide the Precipice, which he had often ſeen, being called to mind, it could not be otherwiſe but upon the concurrence of theſe two things, he muſt needs be admoniſh'd to uſe great Caution for his ſafety in getting into this Hole; and it was but natural for a *Creature* that was to undergo ſo great a danger, to catch hold upon any thing that might help him in his leap; and ſince there was nothing that offered it ſelf at that inſtant beſides the *Broom Bough*, which by chance hung over the *Hole*, he caught hold on the ſame with his *Mouth*, and thereby gaining an opportunity of poiſing himſelf for the better fetching of a new ſort of leap, he threw himſelf cleverly into the ſaid *Hole*; mean while the *Dogs* purſuing the *Chace* with the ſame ſpeed and eagerneſs as before, were upon the brink of the Precipice before they perceived there was any danger there, in which extremity, neither being able to retreat back, nor to put a ſtop to their career, they fell in and periſh'd in their fall. Yet all this while there is no neceſſity to imagine, that the *Fox* contrived this deſtruction for them, or brought them deſignedly into this deſtructive Path; but in the firſt place it was effected by his meeting with this refuge from the hard purſuit of the *Dogs*; and next he was prompted by his *Memory*, which had upon ſome ſuch like caſe before ſuggeſted to him, how to ſhift for himſelf when-ever the neceſſity of declining the like danger ſhould require.

XXXII. *Certain Phænomena which indeavour to prove that Ratiocination belongs to Brutes.*

And here what hath been already ſaid, induceth us not to paſs by certain *Phænomena*, by which ſome take upon them to attribute to *Brute Animals* the faculty of *Ratiocination*, and judge them to be indued not only with *Cognition* and *Perception*, but with *Diſcourſe* alſo. For example, when a *Dog* hath two ways to go in queſt of his *Maſter*, he thus ſeems to reaſon with himſelf; my *Maſter* certainly went one of theſe two ways, as is evident from the ſcent of his *Footſteps*, but he went not this way, therefore he muſt needs have gone this way. And when a *Dog* in purſuit of his *Prey*, comes to a threefold *Path*, the firſt and ſecond being ſmelt to, and found not to be the right, he immediately without delay, or putting his *Noſe* any more to the Ground, takes his progreſs through the third. But the real cauſe of theſe two *actions* is no other than the inſtinct which *Nature* hath infuſed into theſe ſort of *Animals* to perform ſuch and ſuch *actions*.

For in regard a Scent evaporates by a continual effluvium from *Man*, *Hart*, *Buck*, *Hare*, &c. and adheres to other things, the *Dog* hunts out the ſcent of *Maſter*, *Hare*, *Hart*, &c. impreſt upon the *Veſtigia* or *Footſteps*, and being not in the leaſt moved by the *ſcent* of the traces of any other Body, no wonder if he take that way by which his *Maſter* or the *Hare* went. Nor is it to be objected that the *Dog* doth not this by his Scent, but only induc'd by this ſort of reaſoning, *The Hare hath made his eſcape by one of theſe three ways, but he is not gone this way nor that way, therefore it muſt needs be that he hath made his eſcape by the third way.* Foraſmuch as this is but a meer fiction, and not the reaſoning of a *Dog*, but of a *Man:* For the *Dog* is no other ways but by the *ſcent* led into that Path to which he is induc'd by his quick *ſcented Noſe*; for when he finds it, he pricks up his *Ears*, and with great ſpeed purſues his *Prey*, becauſe the vapour of the *ſcent* filling his *Noſe*, he hath no more to do, but to give himſelf the looſe and follow the tract of it. Whereby it evidently appears, how different this way of *Operation* is from *Diſcourſe* or *Ratiocination*; ſince the *Dog* advances not from one *Cognition* to another, nor diſcovers any unknown Verity by the help of another known. For ſuch a power is capable of *Intellect*, becauſe of its *Perception*; and of *Will*, becauſe it applies the *Intellect* to *Inquiſition*, and *Conſideration* of its *Object*. Which Faculty ſeems to be inſtead of a conſequence of a *Created Mind*. For *Brute Animals*, as LUDOVICUS VIVES obſerves in his Second Book *De Anima*, begin not from *A* and ſo paſs on to *B* to know *C*, nor from *B* as conjunct and proceeding from *A*, but becauſe *A* pleaſeth not, they ſeek another thing, and ſo fall upon *B*; as when a *Dog* follows his *Maſter* hunting after a *Wild Beaſt*, he both by *ſcent* and *ſight* diſcerns him to be a *Man:* If it be correſpondent with the *ſcent* and *aſpect* of his *Maſter*, he reſts ſatisfied, tho' it be not the very ſame perſon; but if otherwiſe, leaving him, he betakes him to another, thence to another, tho' having no coherence with the former, till he lights upon him whom he ſeeks.

XXXIII. *How it is that the Torpedo catches other Fiſhes.*

Among the ſubtile *Wiles* of *Brute Animals*, the Craft of the *Torpedo* or *Cramp-fiſh* uſes to be made mention of. This *Creature* is skulking in muddy places, the better to lie in wait for ſmall *Fiſhes* which it feeds upon, caſting ſuch a numneſs upon them, that as ſoon as ever they riſe above water it eaſily catches them, and devours them. Moreover, the Writers of the Wonders of *Art* and *Nature*, deliver of this *Fiſh*, that by touching only the Line of an *Angle Rod*, let down into the *Water*, it conveys quite up to the very Hand of him that holds the Rod, ſuch a

benumming quality, that be he never ſo ſtrong a *Man*, he finds all the *Joints* and *Sinews* of his *Hands* and *Arms* ſo enfeebled, as not to be able to hold any thing in his *Hand*, and ſo likewiſe in his *Legs* and *Feet*, as not to go at leaſt with any ſpeed or ſwiftneſs of pace. The Cauſe of all which it will not be very difficult to demonſtrate, if we conſider that it is Natural to this and other ſorts of *Fiſh* of a cold Nature, ſo to cover and as it were arm themſelves with *Mud*, that the *Fiſhes* when they approach, are upon the emiſſion of this Venenous quality, immediately ſeiz'd with ſuch a Numneſs as if they were all frozen and bound in *Ice*. Foraſmuch as ſuch ſort of *Spirits* are emitted from the *Body* of the *Torpedo*, as penetrating the ſubſtance of the *Fiſh*, or reaching the *Hands*, *Feet*, or other *Members* of thoſe that touch, benum their *Spirits* coming forth to meet them, and conſequently ſtupifying thoſe parts of the *Body*, render them feeble, tremulous, and unapt for *motion*, and that ſo throughly, that the buſineſs is effected before the *Fiſh* are taken either by *Net* or *Angling-Rod*. The ſame may be ſaid of the *Sepia* or *Cuttle-Fiſh*, who finding danger approaching from the hands of the *Fiſherman*, ſends forth a certain *black Liquor*, by which the *Water* being all ting'd, and putting on a black or ſable Hue, he dexterouſly failing all the Arts of the *Fiſhermen* gets away ſafe and ſecure. But neither doth this Stratagem any more, than any of the reſt, proceed from any Diſcourſive Faculty or act of Reaſon, but from a *laxation* or looſning of the *Nerves* cauſed by *Fear*; as hath been already diſcourſt concerning the *Fox*, who for *fear* voids his *Urine*; ſo the *Cuitle-Fiſh* vomits out a Liquor much like *Ink*, from the diffuſion whereof through the *Waters* proceeds the fore-mentioned Effect.

XXXIV. *How comes it to paſs that Brute Beaſts fear Men, and fly the ſight of them.*

Neither doth it argue more of Reaſon, that *Beaſts* ſtand in fear of *Men*, and uſually fly and decline the ſight of them as *Enemies*, ſince that *fear* proceeds from the remembrance of ſome *damage* which at ſome time or other they have received. For the Cauſe of Paſſions, as well in *Brute Animals* as in us, is nothing elſe but the *Agitation* by which the *Spirits* ſtir up the *Glandula* which is placed in the midſt of the *Brain*, from the inequality of whoſe *agitation*, and the variety of parts whereof they conſiſt, the *Spirits* themſelves are diverſly deduc'd into the *Muſcles*, and create different Affections. Whereupon, when the *Spirits*, which conſtitute the *Idea* of any thing, have once form'd a way to themſelves, and intruded themſelves among the *filaments*, of which the ſubſtance of the *Brain* is compoſed, there is not requir'd ſo great a force by which they are obliged a ſecond time to repeat that way, as was needful at firſt to prepare the ſaid way for them; whence it comes to paſs, that when the like *Species* ſhall be form'd upon the *Glandula*, that facility alone which they find of advancing through their firſt path, will ſuffice for them again to enter it. Wherefore, no wonder if *Brute Animals* for damages offer'd them by *Men*, or Terrors thereby incurr'd, are not able for the future to look upon them, but that the *Idea* of the harm muſt preſently occur, and they thereby be ſtirr'd up to flight; as we ſee in ſome *Men*, who having drunk a *Medicin* with great averſion, cannot after that eat or drink any thing that hath the like kind of *taſte* or *ſavour*, but with great abhorrence and averſion; nor can in like manner ſo much as think of the averſion uſual in taking of ſuch *Medicins*, but that the ſame muſt return again into their *Minds*. And that this is the true and genuine Cauſe why *Beaſts* fly the ſight of *Men*, may hence be confirm'd, *viz.* becauſe there are many *Regions* diſcover'd (eſpecially in the *New World*) where it is found by Experience, that neither *Birds* nor *Beaſts* do in the ſame manner fear or fly the ſight of *Men* as among us, who treat them more inhumanly, and ſuffer no place where ſuch Creatures harbour to be at reſt from our *Fowling-Pieces*, and our *Venatory Inſtruments*. Moreover, it is obſerv'd in the Iſland of *Chio* and other places, that *Partridges* never fly away, but are kept tame in great *Covies*, and oftentimes betake themſelves in great numbers into thick inhabited and frequented *Towns* and *Villages*, no otherwiſe than as *Sheep* are fed and kept in *Folds* among us.

XXXV. *How it comes to paſs that young Animals, who never ſaw Men before, ſhould fly them at firſt ſight.*

But there remains yet one Difficulty to be ſolv'd; for tho' *Beaſts*, who have ſuffer'd injury from *Men*, may by the benefit of their *Corporeal Memory* be affrighted at the ſight of *Men*, and upon diſcovery thereof betake themſelves to *flight*; yet how comes it, that young *Animals* who have not ſeen the *Face* of *Man* before, ſhould ſhrink back and be ſhy at the ſight of what they have not yet ſeen? For the ſolution of this Difficulty, it will be ſufficient to mind what hath been diſcourſed in my *Philoſophical Inſtitution* and *Hiſtory of Nature*, concerning ſome *Sympathies* and *Antipathies* of *Men*, namely, that the *Image* of a thing ſeen being depainted in the *Brain*, is by the help of the *Animal Spirits* convey'd into the common *Senſorium*, or Seat of the *Senſus Communis*, and from thence by the mediation of the *Blood* and *Spirits*, to the *Uterus* or *Womb*, and through the *Umbilical Vein* to the *Birth* it ſelf, in which the *Image* of the thing ſeen, becauſe of its ſoftneſs is ſtrongly imprinted, which tho' in the beginning it be but ſmall, yet by little and little the ſubſtance of the *Birth* being enlarg'd, it increaſeth juſt as a Letter engraven with a *Penknife* in a *Pompion*, or the *Barks of Trees*, is dilated, and by degrees receives Increment through the *Bark*. For it cannot be doubted, but that *Brute Animals* having receiv'd damage from *Men*, or an impreſſion of *Fear*, tranſmit the *Species* thereof into the *Birth*, foraſmuch as by thoſe *motions* their Temperament is alter'd, and the diſpoſition of Parts inverted, which afterwards being communicated to the *Birth*, by the *Seed*, generate the ſame propenſion therein. For we ſee it happens very often in the *Sons* of *Mathematicians*, that they are more delighted than any other ſort of *Men* in the *Drawing* of *Figures*, and deſigning of *Proportions*, and that they are led as it were by a certain Inſtinct of *Nature* to the learning of thoſe kind of *Arts*, which undoubtedly from their Nativity they are addicted to, and that upon no other ground but from the *Imagination* of the *Parents*, which altering the Nature of the *Seed*, and inverting the Temperament of the whole *Body*, imbues the *Birth* thence ſpringing with the ſame propenſities.

XXXVI. *How ſome Beaſts come to be ſo Capable by Inſtruction and Diſcipline.*

The time now requires, that we ſhould paſs on to the third *Claſſis* of *Actions*, that is, of ſuch as *Animals* attain to by Exerciſe and Diſcipline, and which ſeem ſo wonderful to thoſe that obſerve and conſider

consider them, that they can hardly be otherwise persuaded, but there is *Cogitation* in these *Creatures*. The *Hawk* is taught by his *Instructor* how to hunt after *Partridges*, and other sorts of *Birds*, and with erected *Ears* receives his *Instructors words*, andwhen he is let fly to *catch* the *Prey*, upon the *Falconers* hortatory Outcries, encouraging him still to a stouter prosecution of his *work*, he grows fiercer and fiercer, and follows the Enemy with an extraordinary ardour of *Spirit*. The Famous *Justus Lipsius*, in his first Century of *Epistles* to the *Hollanders*, makes mention of a *Dog* of a *British Race*, who was taught to go to *Market*, to carry the *Mony*, and to bring home the *Meat*. It was thus perform'd: They hung a *Handbasket* about his Neck, with *Mony* in it for so many Joints of *Meat* as there was occasion for; with this the *Dog* goes directly without stop or stay into the *Market*, to a known *Butchers-Stall*, there receives the *Meat*, and away comes the *Dog* with his *Marketting* home. *Setting-Dogs*, who have an innate Inclination to set upon *Partridges*, are so taught by Art, that upon the sight of them they are to stand unmov'd, and never till the Sign be given, to rise or move a Foot. ARRIANUS is Cited by CARDAN, as relating that he saw an *Elephant*, who having two *Cymbals* in his *Ears*, toucht them alternately with his *Snout* or *Trunk*, to a certain *Tune* that was set for that purpose, and *danc'd* to the Measure of the said *Tune* in Consort with others that were engaged and had a part in the said *Dance*.

XXXVII. *The Cause of the diversity of Motions in Animals.*

These Operations in *Animals* will be more clearly made out, if it be granted that the double *Nature* of *Brutes* proceeds from the different texture of the *Fibres* and quality of the *Humors*; whereby it comes to pass that some are more propense to one Motion of *Passion*, others to another, to which the unequal commotion of the *Spirits* in them doth not a little conduce. For since some of those parts of which the *Spirits* consist are more gross than others, and rais'd to a quicker Motion, the said *Spirits* pass on by a direct *Line* into the *Cavities* of the *Brain*, and from thence are led into other *Muscles*, into which they had not been led had they been endued with less force.

XXXVIII. *How a Hawk is to be brought up for the better catching of its Prey.*

The *Hawk* therefore being a *Creature* Voracious by Nature, and adapted by Kind to follow *Prey*, is without any difficulty taught to bring it to us, if we contribute to the improving its *Nature*, and accommodate our selves to its *Inclination*, since this whole business chiefly consists in this, namely, to keep the *Hawk* as much as may be from *Sleep*, and almost continually to be stroaking it, so to make it to become Tame to that degree, as scarcely to take any *Meat*, but from the *Fist*; which familiarity being for some days used, it becomes accustomed in time to fly after its *Food*, thrown at some distance from it: In the next place, to hunt after a *blind Pigeon* let loose before it, which if it catch, that being snatcht out of its *Talons*, another piece of *Flesh* is cast before it, to feed upon, as given for a reward of its Labour; which Exercise being for some time repeated, the *Hawk* accustoms himself by degrees to fly after all *Birds* whatsoever, and when taken leaves them for the *Master*, being himself contented with a small Reward. Whence it is to be concluded, that all this work consists chiefly in this, That the *Hawk*, as is inbred in him by Nature to do, accommodates himself to the Art, and follows that Rule of *feeding* which Nature hath prescribed potentially, but which is improv'd by the Instruction by us given for our advantage and pleasure, in which obsequiousness of the *Hawk* nothing of Reason is to be discern'd, but only the Industry of the *Instructor* appears.

XXXIX. *How Animals are capable of Discipline.*

As to those *Animals* that are capable of Discipline, as are *Dogs*, *Elephants*, *&c.* it must be consider'd, that the Discipline whereof they are capable depends principally on the *7th* pair of *Nerves*, for from thence it is that the *Nerve Auditive* hath communication by its Envelopement, and, it may be, likewise by its *Fibres* with the Branches, which advance some to the *Exteriour Ear*, others to the *Muscles* of the *Larinx*, others to other parts of the *Body*; and hence it is that *Animals*, when they hear any *Noise*, cannot but erect their *Ears*, utter their *Cries*, and move themselves after their several ways; the Reason is, because when the *Nerve Auditive* is touch'd and excited, the other *Nerves* with which it hath communication are mov'd in such sort, that the *Animal Spirits* are disposed to flow into the *Muscles*, which serve for the Moving of the *Ears* and other *Members*.

XL. *How we are to conceive of a Dogs Catching-hold of a thing.*

This Communication of the *Nerves* of the *Hearing* with that of the *Voice*, and other parts being granted: It is evident that when we see a *Dog* ready, for Example, to catch hold of any thing, there needs no more to be done, but to shew him a piece of *Bread*, and to cry at the same time that he is in this posture, *Hold fast*, for the Noise of that *Saying* will not fail to cause the *Animal Spirits* to flow across from the *Brain* at that very time that the presence of the *Object* causeth others to flow into the *Muscles*, which serve to make the *Dog* catch hold, which being reiterated several times, the *habit* thereof may in such sort joyn the two Courses of the *Animal Spirits*, that at last the only uttering these words, *Hold-fast*, will be capable not only to excite the Courses of the *Animal Spirits*, which are answerable to one another, but also that which serves to cause the *Dog* to *Catch hold* without any necessity of the *Bread* being there.

XLI. *By what Art the Dog at* Brussels *was taught to go to the Butchers and bring home Meat.*

By the like Care and Art *Dogs* are taught to carry *Letters* and other things to any certain *place*, as LIPSIUS reports of the *Dog* at *Brussels*, who doubtless was brought to it by continual Use and Custom. There is no question, but a *Master* or *Servant* taking a *Dog* along with him to the *Shambles*, gave him *Meat* for a reward of his Labour, and afterwards hanging a *Hand-basket* about his *Neck* return'd with him to the same place, and renew'd the Reward; to which Service the *Dog* was so accustom'd, that whenever the said *Basket* was hung about his Neck, he made to the *Shambles* of his own accord, and having received his Burthen, return'd home. But no Man I think will attribute this action to Judgment or Reason, but only to Assuefaction or Custom gain'd by long use, which may be easily evinc'd from the Event: For if it hapned, as the same LIPSIUS observes, that in his way home other *Dogs* invited by the scent should come smelling a bout him, and set upon him to take it away, then must he be driven either to defend

defend the *Basket* and put the *Invaders* to flight; or if overcome by number or ſtrength, to fall in with the reſt and take his ſhare of the *Prey*; by which it is evidently demonſtrated, that the Image impreſt in his *Brain*, of carrying the *Basket* to his Maſter, was diſturb'd by another ſtronger Image, namely of repelling the *Invaders*, which latter Image a third yet follow'd in order, to wit, of taking ſhare of that *Fleſh*, for the preſervation whereof he had a little enter'd Combat, that is to ſay, this laſt Image conducting the *Spirits*, which are inſervient to the Motion of the *Body* into the *Muſcles*, another conformable Action objected, was produc'd, which was at the ſame time delineated in the *Brain*, and this could be no other, than that of partaking of the *Fleſh*, which as the caſe then ſtood was repreſented as the moſt convenient and profitable for him. And not much unlike this laſt, was the Education of another *Dog* mention'd by PLUTARCH, who was ſo well Inſtructed, to repreſent *Arguments* and *Perſons* in a *Scene*, that no *Stage-Player* could do it more neatly and exquiſitly, and particularly he took upon him the perſon of a *Man* that took Poyſon in a piece of *Bread*, that is to ſay, a Morſel of *Bread* dipt in a Liquor which was feign'd to be *Poyſon*, upon which he counterfeited to tremble, to totter in his gate, to be taken with a deadneſs and heavineſs, and in the end he fell, and with his Limbs ſtretch'd out lay for dead, then was removed and laid out as for Burial, as the Argument requir'd; yet after all this, when nothing leſs was expected, in the twinkling of an Eye, he firſt came to himſelf as it were out of a Dream, began to move his *Head* and *Members*, to open and roll his *Eyes* about, and laſtly aroſe and went joyful and brisk, to ſhew himſelf to him for whom he had done all this.

XLII. *How a Dog is taught to Set for Partridges.*

But to proceed farther, That ſome *Animals* are taught to act contrary to their own proper *Inſtinct*, and omit that which they ſeem to be impell'd to by a certain force of *Nature*, doth no more than the reſt evince, that they are any way endued with *Reaſon*; ſince we ſee in *Men*, that divers Motions of *Fibres* or *Spirits* which repreſent Objects to the *Mind*, or excite certain *Affections*, do by long uſe, and ſometimes alſo by accident, excite other ſucceſſive Motions. For although the *Motions*, as CARTESIUS excellently, after his manner, affirms in his Treatiſe of the *Paſſions*, both of the *Glandule*, *Spirits* and *Brain*, which repreſent ſome certain Objects to the *Soul*, be naturally joyn'd with thoſe which excite therein certain *Paſſions*; nevertheleſs they may by *Habit* be thence ſeparated, and be joyn'd with others of a very different Nature; nay, this *Habit* may be acquir'd by one only Action, and that without long uſe. As for Example, when on a ſudden and beyond Expectation ſome very loathſom thing ſhall be found in *Meat* that is eaten with a very greedy Appetite, this ſudden chance may ſo alter the diſpoſition of the *Brain*, that thenceforth the very ſight of that *Meat* may poſſibly not be endur'd, which formerly was eaten with great delight, which very thing is alſo obſerv'd in *Beaſts*: For tho' they are void of *Reaſon*, and all manner of *Cogitation*; yet all Motions of the *Spirits* and of the *Glandule*, which excite *Paſſions* in us, are alſo in them, and ſerve for the preſerving and confirming, not as in us of the *Affections*, but of the Motions of the *Nerves* and *Muſcles*, which uſe to accompany them. So when a *Dog* ſees a *Partridge*, he is Naturally inclined to run after it, and when he hears the ſound of a *Muſquet* ſhot off, that Sound naturally diſpoſes to flight; yet it is an ordinary thing for a *Setting-Dog* to be ſo Inſtructed, as to ſtop at the ſight of a *Partridge*, and on the other ſide, to run after any thing ſhot out of a *Gun* upon hearing the Report thereof; to do which they are not led by Judgment, as I ſaid before, but by the fear of *Stripes*, or ſome kind of Diſcipline, by which the Motions of the *Spirits* and *Nerves*, joyn'd by Nature with certain impreſſions of *Objects*, are totally diverted and remove into other parts.

XLIII. *How an Elephant is taught to beat upon Cimbals.*

But that an *Elephant* ſhould beat upon *Cimbals* tied to his *Ears*, is no great matter of Admiration, ſince by a ſmall deal of Induſtry and Diſcipline he might eaſily be brought to it; in regard this *Animal* is of a very capacious and hot *Brain*, and conſequently eaſily imitates thoſe things which are propoſed to it. Add hereunto, that he hath a prompt and ready *Proboſcis*, capable of touching the *Cimbals* alternately, and thereby producing a certain rude, if we may ſo call it, *Harmony*, by which all thoſe who were preſent were induced to a Dance, according to the Laws or Rules aforehand preſcribed.

XLIV. *The Cauſe of theſe Operations in Brutes is only Memory, and the diſpoſition of the Parts of the Body.*

From theſe few examples it plainly appears, that Cognition is not required to the performances which we behold in Brute Animals; but that *Memory*, the *hability* of the Members of the Body and Cuſtom ſuffices: Or if any one will needs call them the works of Reaſon or Intelligence, they may indeed be ſo allowed, but not of the Reaſon of the Animals, but of thoſe who have inſtructed and taught them. Now if any one will have it, that Beaſts are taught ſome actions by example and the imitation of others of the ſame Kind, and by inſtitution; VIVES anſwers them in the above cited place. Brutes, ſaith he, teach their Young Ones to do that ſooner, which nevertheleſs they would do of themſelves; as a Bird teacheth her Young Ones to fly, a Cat her Kittens to hunt after Mice, that they may have the benefit of ſeeing them like themſelves as ſoon as may be, that is to ſay, perfect in their Kind; but we teach them to do what we would have them do, which they elſe would either never do, or at leaſt in another manner than we deſign. Nor is our Doctrin any other thing in them than meer *Aſſuefaction* or accuſtoming themſelves, and that to nothing elſe but to ſome Corporeal Exerciſe, as to Speak, to Run, or in ſome manner or other to move their Body, or ſome part of their Body.

XLV. *By ſome Examples it is ſhewn, that Beaſts diſcourſe one another, and underſtand Human Speech.*

As to that manner of Speech or Diſcourſe by which ſome Animals ſeem to ſpeak to one another, and to diſcover thereby what their thoughts or deſigns are; this appears moſt clearly in the Hen, who according to pleaſure varies, and by divers Tones makes manifeſt the ſeveral Affections wherewith ſhe is impelled; for if ſhe calls out her Chickens, ſhe feigns the Tone of a Raven; if the Kite be hovering over her, ſhe drawls out, and ſomewhat elevates her Voice; if the Chicken chances to be catcht, ſhe as it were groans and repeats that Tone with a kind of a Sob, *&c.* Hence PORPHYRIUS imagined, that Animals had converſe

converse with each other by Speech, and that *Thales*, *Melampus*, *Tiresias* and *Apollonius Thyaneus* understood their Language, as *Virgil* relates of *Helenus*, in the Third Book of his *Aeneids*,

——Who knowst the Stars,
And Speech of Birds.

A *Parrot* falling out of a Window, in *Whitehall*, in the time of King *Henry* VIII. into the River *Thames*, flowing by the said Palace, began to cry out *a Boat, a Boat*, 20 *l.* for a *Boat*; whereupon being taken up all wet by a Waterman, he was brought to the King in expectation of the promised hire, but the Parrot, then altering his Tone, cried out, *Give the Knave a Shilling*. A *Magpie* sometimes so exactly imitates the Voice of the Fowler, as thereby to impose upon the Dogs, and draw them on, while they take it to be the Voice of the Master. The same thing PLINY relates of the *Hyæna*, who counterfeiting Human Voice among the Shepherds Cottages, and having learnt the Name of some particular Person, calls him out by the said Name, whom coming forth by Night, he sets upon and tears to pieces. *Horses*, *Dogs* and *Apes* we find understand very well the speech of Man; forasmuch as they receive all their Dictates and Commands, and accordingly execute them. An Example hereof JUSTUS LIPSIUS gives us in a Dog at *Lovain*, who having letters sowed up in his Collar, and understanding by the words spoken to him, whither they were to be carried, went directly to *Brussels* with them, to a certain House well known to him, and there left them.

XLVI. *How a Hen varies her Voice.* That certain Animals do as it were attemper and manage their Voices, and seem after a sort to utter various sounds at pleasure, is not to be supposed to proceed from Reason, and as if there were a certain Mind latent in them, by which their sounds were directed, but only from the Passions by which they are agitated: Which Passions inducing a various disposition in the Organs, are the cause that the Spirits are diversly emitted through the *Aspera Arteria*, and accordingly Beasts utter their various Tones, even as we experiment in our selves, who inflamed with Love, speak after one manner; affected with Hatred or Anger, after another. And altho' Cogitation may accompany the Motions of our Passion, that is to say, in regard we are indued with a faculty of thinking, yet it is most evident, that those Motions do no way depend upon this Cogitation, in regard they oftentimes arise against our Will, and consequently the said Motions may very well be in Brutes, nay, and possibly more vehement than in Man. Yet can it not be from thence concluded, that they are indued with Cogitation. Different is the *Pipation* of a *Hen*, in regard she is affected with one Passion when she falls upon her Food, with another when she sees the Kite, with another when she is taken, with another when she calls away her Chickens, with another when she goes to Roost: So that we can never enough condemn those Persons of Vanity, who in Antient Times have taken upon them to understand the Languages of Beasts, and pretended to know by their manner of Speech what they designed or acted.

Parrots indeed are taught to form articulate sounds, and by Custom are brought to pronounce many words, and yet they cannot properly be said to speak. For to Loquution or Speaking, two things are chiefly required, *Motion* of a Corporeal Organ, and *Perception* of Mind. For as in Sensibility there are three Degrees to be distinguished, as I have already hinted, *viz.* *Motion* of a Corporeal Organ, *Cogitation* of Mind, and determination of *Will* to judge; so in speaking, the first Degree is Perception of Mind; the second, Judgment and Will to discover to another that which we conceive; the third, the Motion of the Corporeal Organ. Now in some Animals there is the third Degree of Speaking, but not the second or third: Because whereas Beasts are void of Mind, they design not by those words which they utter, to discover their internal Conceptions, but only declare those things, which by long labour they have learnt of Men, and whose signification, in time, utterly slips from them: For if some Birds have been so instructed, as to give some things their right Names, and promptly to answer to Questions ask'd them, this is only to be attributed to their Memory, no to their Understanding or Reason; as particularly in that *Parrot*, who, falling out of a Window of the King's Palace into the River of *Thames*, called out for a Boat, since there is no doubt, but he had formerly learn'd to pronounce those words, whereby it came to pass, that the species of them being by very frequent repetition impress in the Brain, the Spirits and Organs were determined to put forth the like sounds. As in that *Magpie*, which upon the sight or approach of his *Mistress*, used to utter the word χαιρε, *i. e. God save you*, in regard this Sound or Voice accompanied such an affection, namely the hope of some good thing for the Belly, in regard that upon the uttering of this word he had been always used to be presented by her with some or other more delicate Bit than ordinary. In like manner, all those things which *Dogs*, *Horses*, or *Apes* are taught, are no other than the Motions in them of Hope, Fear or Joy; in so much that there is not in the least any need of Cogitation in them for the performance of these things.

XLVII. *Parrots do not properly speak.*

As for the *Magpie*, *Hyæna*, and such like Creatures imitating Human Voice, it can be attributed to nothing else, but to the sensitive plexus or texture of the Fibres, and the disposition of their Organs. For their Bodies are so disposed, that when a human sound or accent smites their Ear, the Animal Spirits conduct it into the Muscles which are inservient to the formation of the Voice. And that the *Hyæna* should with a Voice, much resembling human, call forth Shepherds to make a Prey of them, arises from hence; that his Stomach being empty, the species of those Animals on which he used to feed, causes the *Glandule*, inclining it self to impel the Spirits into that part of the Brain in which are the Vestigia or Tracts which the aspect of these Animals left; and since the Image of the Object recurs not to the Brain, but when that also recurs which accompanied it: No wonder the *Hyæna* should feign or imitate Human Voice, being indued with a wonderful docility of Corporeal Organs, and able promptly to express what ever comes to the Ear.

XLVIII. *How the Hyæna counterfeits Human Speech for the devouring of Shepherds.*

XLIX. *How is it to be understood that some Animals have more Instinct than others.*

Thus when they say that these Animals have more of Instinct than others; nothing else is to be understood, but that the interiour and secret disposition of the invisible parts of their Bodies, and principally of their Brain is such, that it receives more easily the different impressions of exteriour Objects, and causes the Members to move in more different manners than those of other Animals.

L. *How it comes that Dogs, Horses &c. obey our Words, and execute our Commands.*

Horses, *Dogs* and *Baboons*, upon certain words or signs given, obey us, and execute our Commands; nor is it therefore just to conclude, that they are indowed with Reason and Intellect, because we find by experience, that if other signs be given them, which tho' in reality more facile, yet are not suited to their innate capacity, they take no notice of the Commands there hinted. For Examples sake, if we should command a Dog to seek out for a Handkerchief lost a Month ago in a Garden, Closet or such like place, as we usually command him to fetch a Stick, just now thrown into a Pond, the Dog, instead of speeding to the Garden or Closet, where it is signified that the Handkerchief was lost, will doubtless make directly to the Pond to look out for the Staff: Whence it plainly appears, that the Dog does not perform what he is commanded, as apprehending the Words spoken or Signs given him; but because the whole *Machin* of his *Body* hath obtain'd that *habit* and *disposition* by Labour and oft repeated Instructions, so that as soon as the Sign is given him, the *Animal Spirits* are streight carried into the *Nerves* and *Muscles*, which dispose him to the doing of this or that thing; and so no wonder if the *Dog* of *Lovain*, having the Letters made fast to his Collar, made streight for *Brussels*, went to the House assign'd, and having discharg'd himself of his *Letters*, return'd directly to his Master, since all things which we see done by *Beasts*, and which so much stir up Admiration in us, are the meer effects of their *Passions* and *Motions*, by which we teach them and have a curb upon them, through the long exercise, labour and use which we are at in the Instructing of them.

LI. *Certain Actions of Animals, wherein they even seem to exceed Men in Sagacity of Wit.*

There are now remaining to be Explained those Actions of *Brutes* which constitute the fifth *Class*, namely those Actions wherein they discover so much acuteness of Wit, that they seem even to exceed in that Rationality by which *Men* are commonly differenc'd and distinguished from them. In the first place it is admirable to see how delicately and ingenuously some *Birds* proceed in making of their *Nests*. For Example, when the *Swallows* begin to be sensible of that alteration of their Condition, which desire and eagerness of Propagation is likely to bring upon them, they design their *Nests* after this manner: The biggest *Straws* and strongest of the *Chaff* being first laid as a foundation, they afterwards lay the softer and the lesser over: To this Fabrick they use Mud for a Cement, and daub their *Nest* all over with it, as with *Mortar*, and when this *Mud* is wanting, they fly to the next *Pond*, and there wetting the end of their *Wings* gather up *Dust*, with which as with *Mud*, they plaister up the rough places, close up the gaping Holes, and in all their Architecture so accommodate the dimension of their Fabrick to the shape of their Body, that they may have room to turn round so as commodiously to harch upon their Eggs, and in such manner to plant themselves, that they may distribute an equal force of heat to all parts. And now their Nest being strewed with Chaff, Mos and Feathers they lay their Eggs, sit upon them, hatch their Chickens, and feed them. Another argument of Providence in Animals is, that upon the approach of *Winter* they remove into foreign Regions, the better to consult for their advantage and subsistence. Of this sort are the *Cranes*, who every year in *Spring* time fly from *South* to *North*, and in *Autumn* fly back from *North* to *South*. The third Argument is, that some Animals presage things to come, and by a certain Cognition foretel those *Phænomena* in the Air which hang over us; as the *Heron*, when she flies very high, and soars more than usually above the Clouds, predicts future Rain. The *Kite*, on the contrary, mounting up to the highest Region of the Air, and there hovering till the Evening, proclaims fair Weather. The same thing we find by experience of other Animals; for Example, the *Cat*, the *Mole*, the *Bull*, the *Ram*, the *Dolphin*, the *Duck*, the *Cock*, &c. which either by Voice uttered, by Crowing, by Frisking about, or the like, presage various sorts of Weather.

LII *With what impulse Birds are carried in building their Nests.*

As to the Birds building their Nests at a certain season of the year, afterwards sitting upon their Eggs, hatching their Young Ones, nourishing defending and covering them, *&c.* this ariseth only from the mutation of the temperature of their Body; by which the Fibres, and their Contextures, in those Organs, especially which serve to Propagation, are so dispos'd, that that affection is easily thence derived, which prompts them to build their Nests, brood upon their Chickens, feed them when hatcht, *&c.* For to close with the Sentiment of the most Noble DIGBY, I think there is no Man will deny but that the desire of Copulation in Birds, proceeds not from any impulsion or design of begetting their like, but from the temperament of the Blood and Spirits, produc'd by quality of the Food wherewith they are fed, together with the Season of the Year; however, after Copulation it must of necessity follow, that the Eggs grow in the Belly of the Female, and still increasing create trouble to her, and stir up a desire in her of being at rest, and of freeing her self from the burthen she labours with. And as *Dogs* and *Cats*, when necessity urges, are wont to look about for some commodious place, not only for the bringing forth of their Young, but also for voiding their Excrements. So *Birds* when the weight of their Eggs burthens them, and renders them unapt for flight, begin to indulge themselves very much to their repose, and take much delight in soft and warm places, so that Chaff, Mos, and the like, please them with their softness, which they therefore carry to their Nest. But that this action is not guided by Reason, is evident even from the very manner by which it is performed: For when they light upon Chaff, or any other thing commodious for the Litter of their Nests, they do not, as I have often observ'd in several Birds, carry it directly to their Nests, but first make towards the Bough of some Tree, or the Top of some House, and there with this piece of Houshold-stuff in their Bill, hop up and down for some time, then leaving this place, fly to another,

another, where after a ſmall time of ſome ſuch like diverſion, they at length betake themſelves to their Neſts; wherein if the Straws or chaffy Stalks ſhould lie in a confuſed heap, they would be ſubject to be prickt by the ſharp ends of them; whereupon they turn them up and down, till all the ſaid ſharp ends be laid ſmooth, and their decumbiture be ſoftned and made eaſie. Which we only ſeeing done, and comparing the Production thereof with the Method which we our ſelves ſhould uſe in an exerciſe of the like actions, may poſſibly allow this diſpoſition of Chaff Stalk to be prudent and directed by Reaſon. But whereas it proceeds from Birds themſelves, it is no other than a frequent turning this way and that, of Bodies which offend the Senſe, till ſuch time as they bring no further pain or trouble with them. As to the dawbing over their Neſt with *Mud*, it may be aſcribed to the vehement heat which predominates at that time of the Year; for hence it comes to paſs, that they delight to be converſant in Mud, Water and Sand, without which all Birds would quickly ſicken and be deprived, firſt of ſight and then of Life; but the ſame Mud, which, becauſe it refrigerates or cools, they carry to their Neſt in their Bills and Feet; the ſame, I ſay, when it begins to grow hard and troubleſom, they wipe off, and making a hole through in the place where they reſt, they fly out to get that which is freſh and cool.

L. *Thoſe Birds are led by prince white-mouron one tion to anoth.*

As to thoſe Birds, which upon the approach of *Winter*, remove from one *Region* to another. It is not to be aſcribed to their Prudence or Providence, but to their Natural Inclination, by which they are eaſily impelled to remove from a colder to a warmer place, into which afterwards the ſame temperament ſucceeding anew, they return again, provided the ſaid Regions be not very far diſtant from each other, and not uneaſie in acceſs; otherwiſe I am apt to believe that the ſaid Birds would betake themſelves into certain hiding Holes like *Dormice*, *Serpents* and *Inſects*, and there lie dormant all the *Winter*, which might be proved by many inſtances, but it will be ſufficient to mention the *Swallows*, which in the congealed Lakes of *Poland*, lie all the *Winter* time unmoved, and as it were, dead; but the returning heat diſſipating the Froſt, and the Ice diſſolving into Water, they riſe out of their Lakes, and betake themſelves anew to their flight. Which when that *Poſſevinus*, who went Embaſſador into *Ruſſia*, as *Gaſſendus* mentions, would not give credit to, a great flake of Ice was commanded to be brought into his Stove, in which a cluſter of *Swallows* lay crouded together; which when the Ice began to melt by the heat of the place, were obſerved by degrees to move Feet, Wings, Head, and then the whole Body; laſtly to fly out; but after ſome rounds of flight about the Stove, they fell down dead upon the ground, as having undergone too haſty and unwonted a change of Air. Much of the ſame nature is what hath been obſerved of other Birds, particularly in *Germany*, in Oaks and other hollow Trees, when cut down, *Kites* and *Cuckows* are found to have hid themſelves there all the *Winter*. Something like to this may be alſo thought of the *Storks*, ſince it is yet undiſcovered whence they come, and whither they betake themſelves. Whence PLINY in his Firſt Book, Chap. 23. *No Man diſcerns when they depart, tho' it is apparent that they do go; nor knows when they come, tho' we find that they do come. Both doubtleſs*, i. e. *their coming and going is done in the Night time; and tho' they are commonly ſeen to fly to and fro, yet they are thought never to make their firſt approach but by Night.* From which words it plainly appears, that the *Storks* come not from any far Region, nor go from us into any very remote parts, but ſo keep their way along the Ponds and Lakes, that neither their ingreſs nor egreſs can well be obſerv'd by us.

LIV. *How ſome Animals ſeem to portend future things.*

Laſtly, As to Beaſts ſeeming to foreknow ſome things, we need not for this aſcribe to them any thing of *Divination*, or acknowledge any latent Rationality in them, for the making out of theſe preſages; ſince they depend only upon thoſe mutations which happen in exteriour Objects; which when Animals have received into their Bodies, they are touch'd with certain affections, which diſpoſe them to Crowing or ſhaking of their Wings. For there are always in the Air ſome forerunners of *fair Weather*, *Tempeſts*, *Winds*, &c. which when Animals foreſee, it cannot be but that certain affections muſt ariſe in thoſe Organs which diſpoſe to the forenamed Motions: For in the vivacity of their Senſes *Brutes* excel *Men*; and as thoſe who are depriv'd of ſight, hear more quick than others; ſo it ſeems that Animals being void of Mind, and deſtitute of all Perception, have this recompence, that they have their Senſes more acute.

FINIS.

FINIS.